FINAL REPORT

FOOD TECHNOLOGY FOR DEVELOPMENT PROJECT

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by

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FORWARD

This is the Final Report on the A.I.D. Food Technology for Development Project as carried out by the Food Technology Branch of USDA's Office of International Cooperation and Development. The report summarizes the major activities of the Food Technology Branch during the period 1969-1989, all of which were funded and managed by the A.I.D. Office of Nutrition as a component of that Office's program to help alleviate malnutrition in developing countries.

The Report consists of (1) an introductory section explaining the history, scope, and methods of operation of the A.I.D. Food Technology for Development project, (2) a series of sections outlining the purpose, procedures, and accomplishments of the major components of the project, and (3) a brief commentary offering thoughts and suggestions about future A.I.D.-supported, nutrition-related food technology activities. Attached to the Final Report are five reports describing subactivities carried out under USDA management by USDA cooperators supported with funds provided tnrough the Food Technology for Development Project. These include Final Reports from Colorado State University, Texas A&M University, Iowa State University, Harvard University, and Virginia Polytechnic Institute and State University (VPI).

Copies of the Final Report and all attachments have been made available to the USDA National Agricultural Library, Beltsville, Maryland, and to the A.I.D. Reference Library (Development Information Division, Bureau for Program and Policy Coordination), Rosslyn, Virginia. Both organizations intend to retain the report in their permanent files and will make copies available on request to interested parties. In addition, the A.I.D. Reference Library will maintain copies of all references cited in the Report as well as those cited in the attached cooperator reports, including both published and unpublished documents. Copies of all references will also be made available on request.

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FINAL REPORT
FOOD TECHNOLOGY FOR DEVELOPMENT PROJECT, 1969-1989

1. BACKGROUND

For over twenty years, the Food Technology Branch (FTB) of the Office of International Cooperation and Development (OICD) provided technical assistance to developing countries as a part of the program of the Office of Nutrition of the U.S. Agency for International Development (A.I.D.). The functions of FTB were to (1) provide technical assistance to A.I.D. and A.I.D.'s clients to help utilize food technology in nutrition-oriented projects, and (2) develop new technologies for use in A.I.D. supported programs. FTB's activities were funded by A.I.D. through Participating Agency Service Agreements (PASAs) and Resource Support Service Agreement (RSSAs), A.I.D. mechanisms used for procuring services from other governmental agencies. Expenditures by FTB totalled $12.4 million.

As a result of FTB activities, the concepts of food fortification and use of nutritionally designed food supplements were promulgated and a number of special, inexpensive food products were introduced in developing countries and used by many millions of low-income persons. In addition, FTB has served effectively as a major advisor to the A.I.D. Office of Nutrition and other A.I.D. personnel on a broad range of topics in the fields of agribusiness, food science and technology, food marketing, and related subjects.

1.1 THE ROLES OF A.I.D. AND USDA/OICD/FTB

Congress has determined that the U.S. Government will provide assistance to friendly foreign countries to help accelerate social and economic development. A.I.D. serves as the lead agency for assistance and development assistance funds are provided to A.I.D. through the Foreign Assistance Act. A.I.D. uses the funds for many purposes including the procurement of services from various public and private sources to carry out its mission.

The Foreign Assistance Act empowers A.I.D. to procure the services and facilities of other Government agencies with special capabilities in agriculture and certain other fields to provide technical support for A.I.D. and to give technical assistance to A.I.D. clients in developing countries. A.I.D. procedures specify that the services should be provided through Participating Agency Service Agreements (PASAs) for short-term assistance on specific problems, and Resource Support Service Agreements (RSSAs) for long-range assistance of a general nature. Government procurement regulations permit A.I.D. to utilize the personnel and facilities of other government agencies rather than those of the private sector for technical assistance when the other agency is particularly or uniquely suitable to do so. A.I.D. rules provide that participating government agencies can "subcontract" a part of the services rather than provide them directly if the agencies make a real contribution in identifying and managing the "subcontractors".

RSSA and PASA arrangements are different than contracts or agreements with individuals, companies and non-governmental organizations in that they provide the basis for a partnership between sister governmental units with common goals and objectives. USG employees serving A.I.D. through RSSAs and PASAs can be located in A.I.D. space and perform many of the functions of A.I.D. employees although they are not permitted to sign official documents on behalf of A.I.D., prepare A.I.D. budgets, or represent A.I.D. at official functions. As USG employees working through PASAs and RSSAs, they are in a position to bring not only special technical expertise to A.I.D. programs, but to give a perspective to issues without the vested interests sometimes found in private companies and NGOs.

In 1968, the A.I.D. Office of Nutrition (AID/S&T/N) entered into a PASA with USDA for USDA to provide ongoing assistance to A.I.D. in support of the A.I.D. nutrition program. Subsequently in 1974, the PASA was converted to a RSSA and remained that way through 1989. As a part of A.I.D.'s procurement procedures, it certified that "the resources of USDA are uniquely suitable for the technical assistance to be provided and are not competitive with private enterprise." The RSSA continued with minor adjustments in scope but without interruption from its inception until its termination on September 30, 1989, a period of 21 years.

1.2 SCOPE OF FTB ACTIVITIES

Initially USDA's program focused on activities to improve the protein intake of persons in developing countries and included projects to promote food fortification with protein and amino acids, to stimulate production and consumption of low-cost protein foods, and to support agricultural and commercial activities that could lead to increased supplies of protein. Subsequently, as A.I.D.'s priorities changed, the program was modified to permit USDA to provide a range of technical assistance services under the heading Food and Nutrition Technical Services. During the period 1985-1989, the program was identified as the A.I.D. Food Technology for Development project. Under the terms of the RSSA, USDA undertook research, advised A.I.D., and provided technical assistance to A.I.D. clients on:

- Food fortification with amino acids, proteins and micronutrients, giving particular emphasis to vitamin A during the period 1986-89.

- Production and distribution of food supplements for children through both public feeding programs and commercial sales,

- The development of new nutrition-related food products and processes for use in developing countries,

- New approaches to child survival, and

- Stimulating governments and organizations to incorporate nutritional activities in national programs.

The text of this report summarizes all of the major activities carried out by USDA in support of the A.I.D. Office of Nutrition during the period 1968-1989. Details of the major activities are provided in Attachments which include the final reports covering the principle subagreements.

1.3 ORGANIZATION AND PERSONNEL

RSSA activities were initially lodged in the Nutrition and Agribusiness Group (NAG), a Division of USDA's Foreign Economic Development Service (FEDS). NAG was funded entirely by A.I.D. and was devoted exclusively to work on international nutrition activities on behalf of A.I.D. In 1972, FEDS was merged with USDA's Economic Research Service (ERS) where FEDS became the Foreign Development Division (FDD). Subsequently, in 1974, NAG was transferred to the National Economic Analysis Division (NEAD) of ERS.

In 1977, various elements of the USDA foreign development program were merged to become the Office of International Cooperation and Development (OICD) and NAG became a part of OICD. In 1984, during an OICD review of the functions of NAG and its staff, it was determined that the unit consisted largely of food technologists dealing substantively with food technology, and the name of the unit was changed to the Food Technology Branch (FTB). On September 30, 1989, at the time of termination of the RSSA, the unit was identified as:

The Food Technology Branch

Technical Assistance Division

Office of International Cooperation and Development

U.S. Department of Agriculture

The staff of FTB has remained relatively constant during its 21 year life at 3-4 professionals with a support staff of 1-2 secretaries. The individuals making up the technical staff included the following:

NAME	TITLE	PERIOD
Aaron Altschul 1/	Director	1968-1971
Daniel Rosenfield	Deputy Director	1968-1971
Charles Puttkammer	Staff Officer	1968-1969
Byron Berntson	Staff Economist	1969-1974
Robert Weil	Nutrition Programmer	1970-1989
Paul Crowley	Director/Branch Chief	1971-1989
Edward Alt	Marketing Specialist	1974-1975
Fred Barrett	Food Technologist	1975-1989
Alfred Lachmann	Food Technologist	1975-1985

Because the purpose of the RSSA was to provide technical assistance and advisory services to A.I.D. and A.I.D. clients, the RSSA staff was selected to provide knowledge, skills and abilities which permitted it to deal effectively with the issues which were considered to be of highest priority to A.I.D. at the time. Initially, the staff focused primarily on topics in the fields of chemistry, economics and food technology. As the priorities of A.I.D. and the RSSA shifted, the make-up of the staff changed and ultimately the staff was oriented to focus almost exclusively on food science and technology.

1/ Altschul served as Special Assistant to the Secretary of Agriculture as well as Director of the Nutrition and Agribusiness Group.

FTB (NAG) throughout its history was located physically in USDA offices and reported administratively to USDA. The unit reported substantively to A.I.D. through a Project Manager located within the A.I.D. Office of Nutrition. The A.I.D. Project Manager was Martin Forman during the period 1968-1972, Irwin Hornstein during 1972-1982, and Nicolaas Luykx during 1982-89.

1.4 SUBAGREEMENTS

The functions of the FTB sometimes called for specialized know-how that was not available among its own staff. In certain cases, it was in A.I.D.'s interest for USDA to recruit short- or long-term personnel to augment the FTB staff. In addition, it was sometimes necessary to undertake laboratory and/or pilot plant activities to prepare and analyze food materials, evaluate products and processes, or to experimentally study issues related to the purpose of the RSSA. To deal with these situations, FTB entered into subagreements (contracts and agreements) to obtain the required personnel and facilities on behalf of A.I.D. using USDA's procurement procedures. When doing so, FTB identified the source of personnel and facilities and FTB provided management, leadership, and coordination for the subagreements.

As a rule, FTB's first choice for subagreements was other USDA agencies. During the life of the RSSA, FTB obtained supporting personnel and facilities on a number of occasions from USDA's Agricultural Research Service (ARS), Economic Research Service (ERS), and Food and Nutrition Service (FNS). Because the mission of FTB was closely related to the activities of ARS, a number of FTB's subagreements were with ARS. These included special work on the development of Whey-Soy-Drink-Mix by the Eastern Regional Research Center, soybean utilization by the Northern Regional Research Center and research on rice bran stabilization and recovery of edible rice bran oil by the Western Regional Research Center.

ARS made a particularly helpful input into the FTB program when it assigned Dr. David Fellers, a research food technologist with ARS's Western Regional Research Center, to work as a member of the FTB unit in Washington during 1985-1989. Costs of the services provided by other USDA agencies were paid for by A.I.D. through the RSSA via Interagency Agreements administered by FTB.

FTB also drew on the special expertise of other governmental Departments including the Department of Defense, Natick Laboratories (acceptability tests of food supplements) and the Food and Drug Administration (food fortification). Costs of these services were also paid for by A.I.D. through the RSSA.

When personnel with the required knowledge and skills and laboratory or pilot-plant facilities were not available through either FTB or other governmental agencies, FTB procured them through contracts and agreements with universities, commercial organizations, and individual consultants. 2/

For the most part, supporting services were obtained through cooperative agreements with land grant universities which have been a part of USDA's traditional network of cooperator institutions. Support for the universities' activities was generally provided through the mechanism of Cooperative Agreements which were funded partially with A.I.D. funds provided through the RSSA and partially by the universities themselves as the universities' contribution to a project of mutual interest. Generally cooperative agreements were established as ongoing activities in which the cooperator university provided technical

2/ Procurement of services and commodities was carried out using the usual government procurement procedures practiced by USDA for contracting and purchasing. However in many cases, USDA arranged for services and purchases through the mechanism of cooperative agreements in which USDA supported the activities of a cooperating institution, such as a university, using A.I.D. funds. The essential characteristics of these agreements were that the cooperating institution had special capabilities in the subject area, wished to undertake the activity if supported by USDA, and was prepared to work with USDA on a regular, cooperative basis to assist A.I.D. and A.I.D.'s clients.

assistance in a particular subject area. The major cooperators were Colorado State University (food processing), Texas A&M (commercial food marketing), Iowa State University (food fortification with vitamin A), and Harvard/Massachusetts Institute of Technology (home and village prepared weaning foods). During certain periods of their agreements, Colorado State University and Harvard/MIT maintained project coordinators located with FTB in Washington. These included Ray Hoehle (CSU, 1973-5), David Wilson (CSU, 1975-9), Irwin Hornstein (CSU, 1982-4), and Robert Morgan (Harvard/MIT, 1981-4).

FTB also provided technical assistance to A.I.D. through support to private voluntary organizations (PVOs) such as CARE and Helen Keller International (HKI) and, on one occasion, with a private company, Foremost Food Co. for a marketing study on weaning foods in Central America.

A listing of FTB's contracts and agreements funded by A.I.D. and administered by FTB is given in Appendix 1.

1.5 FUNDING

Funding from A.I.D.'s Office of Nutrition to USDA for FTB services during the period 1968-1989 totaled $12,387,920. The average annual rate of expenditures by the RSSA was $590,000.

As shown in Table 1 below, funding for FTB for services during the period 1968-1973 was $648,425 or approximately $130,000 per year. Expenditures during this phase were largely for salaries and travel of FTB's direct hire USDA employees. After 1973, FTB expanded the use of cooperators and contractors and the funding level was increased considerably. During the period 1974-1983, funding totaled $8,272,495 or about $830,000 per year. Subsequently, when

A.I.D. felt the pressures of funding constraints resulting from Congressional activities to reduce government spending, funding was reduced and during the period 1983-1989, funding totalled $3,467,000 or about $580,000 per year. A complete tabulation of PASA/RSSA funding for FTB is given in Appendix 2.

Table 1. RSSA Funding for FTB, FY1969-1989

RSSA/PASA Designation	Period (FY)	Amount
PASA TA(AJ)1-69 and Amendments 1-10	1969-1973	$648,425
RSSA 1-74 or STB-083-AG-2072 and Amendments 1-24	1974-1983	8,272,495
RSSA STB-0831-R-AG-4207 and Amendments 1-9	1984-1989	3,467,000
Total RSSA/ PASA	1969-1989	$12,387,920

FTB received limited funds from A.I.D. sources other than the Office of Nutrition for technical assistance. Generally funds were provided through PASAs to accomplish specific tasks for USAID Missions overseas. The largest PASA, in the amount of $194,663, was for technical assistance to USAID/Georgetown to modify a weaning food factory to preprocess corn and soybeans for use as ingredients. Other PASAs funded activities for USAID Mission support in Egypt, Peru, and Sudan, and direct funding support was also obtained from USAIDs in certain other countries. However the total amount of Mission funding totalled less than $500,000.

1.6 EVALUATIONS

The performance and accomplishments of the RSSA were monitored by the A.I.D. Office of Nutrition and management reviews and/or evaluations carried out periodically by the Office of Nutrition. Generally formal evaluations were carried out every 3-5 years with participation of all the A.I.D. Bureaus which made use of RSSA services.

A formal evaluation of the RSSA was in progress at the time of preparation of this report but the findings were not yet available. The last formal evaluation for which results are available was carried out in May 1985 and covered the period Jan. 1982 through May 1985. A copy of the 1985 Evaluation is included as Appendix 3.

The A.I.D. evaluations consistently noted that FTB had provided valuable services, had been responsive to the needs of A.I.D., and should be continued and its activities expanded if funds were available.

1.7 TERMINATION

During FY 1989, the A.I.D. Office of Nutrition decided to discontinue the activities of the RSSA and notified USDA that A.I.D. funding support for FTB and all its cooperators would cease effective September 30, 1989.

While A.I.D. did not provide USDA with an explanation for its decision to terminate the RSSA, the action arose after a change in leadership in the Office of Nutrition and as a part of a process in which the Office reexamined its objectives, programs, and organizational structure and made major adjustments. It also occurred during a period when A.I.D. was renewing its efforts to involve the private sector in foreign assistance activities by transferring support for activities from other government agencies like USDA to the private sector.

Although it is not clear at this stage what role "food and nutrition technical services" type activities as provided by FTB might play in the future program of the Office of Nutrition, this report will offer comments and suggestions which might be helpful to the Office or to other A.I.D. units or to other USG agencies

that might replace A.I.D. if any of these decide at some future date to include such activities in their programs either through a qualified government agency, such as USDA, or through the private sector.

2. SUBSTANTIVE ACTIVITIES

The following sections outline the purpose, procedures, and accomplishments of FTB's major activities and provide suggestions for A.I.D. follow-up activities.

2.1. FOOD FORTIFICATION

2.1.1 INTRODUCTION

Food fortification can be defined as the addition of supplementary nutrients to foods in order to improve the nutritional quality and deliver supplementary nutrients. Fortification has been practiced in the developed world for most of this century and the general public has become well acquainted with the concept through consumption of iodized salt, enriched wheat flour, vitamin-mineral fortified breakfast cereals, and a number of other fortified foods. While fortification has been practiced to a limited extent in less developed countries, it has not been used widely to cope with the many serious, nutrient deficiencies found among low-income families except through food distribution programs supplied by developed countries.

In June 1959, the Protein Advisory Group (PAG) of the United Nations proposed that non-fat dry milk powder distributed overseas to the needy should be fortified with vitamin A. Beginning in the 1960s, milk powder procured by USDA for distribution overseas through the Food for Peace program was fortified with vitamin A. Later other Food for Peace commodities, including cereal products and blended food supplements, were fortified with several important vitamins and minerals known to be deficient in the diets of poor people in developing countries. In the late 1960s and early 1970s, many of the Food for Peace commodities were also fortified with protein from soybean flour and the Food for

Peace program became the vehicle for the largest direct nutrition intervention program in the world. Today all of the processed Food for Peace commodities donated by the U.S. for distribution overseas are fortified with vitamins and minerals and many are fortified with protein as well.

In the 1960s, many of the world's leading international nutritionists believed that the major nutritional problem facing developing countries was insufficient, good-quality protein in the diets of the poor. As a result, A.I.D.'s Office of Nutrition focused major inputs on programs to increase protein intake. In doing so, A.I.D. supported a set of activities at FTB to promote consumption of low-cost, high-protein foods.

Certain of FTB's activities dealt with assistance to U.S. and overseas companies to develop and introduce new high-protein food products in LDCs (see Sections 2.2 and 2.7). Other activities dealt with promoting consumption of soybeans and other legumes as low-cost protein sources (see Section 2.9) and with breeding grains with more or better protein, such as high-lysine corn. But in the years immediately before and after 1970, FTB devoted much of its attention to exploration and promotion of protein and amino acid fortification of food.

As a direct result of these activities, chiefly those of Dr. Aaron Altschul, the Director of USDA's A.I.D.-funded nutrition program at that time, protein fortification of food became recognized as potentially one of the most important nutrition interventions in developing countries. Altschul's work culminated in a set of comprehensive food fortification field trials in which wheat was fortified with amino acids in Tunisia, corn with soybean protein and amino acids in Guatemala, and rice with amino acids in Thailand. The purpose for and outcome of these trials are outlined below in Section 2.1.2.

In the early 1970s, the nutrition community revised its position on the importance of protein. Leading nutritionists concluded that food energy should be accorded greater emphasis and also sought to focus more attention on vitamin and mineral deficiencies, particularly deficiencies of iodine, iron and vitamin A.

A.I.D.'s Office of Nutrition responded to this change in emphasis and gave higher priority to energy and micronutrient deficiencies while retaining appropriate programatic emphasis on protein, especially protein in the diets of infants and young children. An outcome of this was the development of the International Vitamin A Consultative Group (IVACG) and the International Nutritional Anemia Consultative Group (INACG), both of which were founded and have been implemented with active Office of Nutrition support. Improved protein in the diets of young children was promoted through activities to encourage production and distribution of low-cost food supplements and weaning foods through public feeding programs and commercial sales, and through support for home and village prepared weaning foods and improved weaning practices. USDA's role in promoting food supplements and weaning foods is discussed below (see Sections 2.7, 2.8, and 2.13) and its activities to help cope with specific micronutrient deficiencies are included in this Section.

2.1.2 CEREAL FORTIFICATION FIELD TRIALS

PURPOSE

During the 1960s, a number of the leaders of the world nutrition community were convinced that cereal fortification with amino acids and supplementary protein could make a major contribution to alleviating malnutrition in developing countries. Others disagreed maintaining that protein fortification "should be rejected on nutritional and logistic grounds".

PROCEDURES AND ACCOMPLISHMENTS

USDA's FTB took the lead in trying to resolve the issue by proposing a set of field trials in developing countries in which tne most basic food staples (corn, wheat, and rice) would be fortified to strengthen the protein, the fortified cereals distributed among groups targeted for nutritional improvement, and tne nutritional impact of the fortified cereals measured.

With leadership provided by FTB's Aaron Altschul and Dan Rosenfield, field trials were designed for wheat fortification in Tunisia, corn fortification in Guatemala, and rice fortification in Thailand. A.I.D. funded these trials. The wheat and rice trials were implemented by Harvard School of Public Health, and the corn trial by the Institute for Nutrition in Central America and Panama (INCAP). FTB monitored the trials for A.I.D. During September 12-17, 1976, a Workshop was held in Boulder, Colorado at which the results of these field trials were reported and discussed (1.1).

The scientists who had undertaken the field trials reported no impact of these interventions on growth of children and, except for a marginal reduction in the mortality rates of children receiving fortified corn in Guatemala, no other significant beneficial effects were observed. (Since Guatemalans have a dietary deficiency of vitamin A, and since the protein fortified corn also contained supplementary vitamin A, it's conceivable that the reduction in mortality rate resulting from distribution of fortified corn is attributable to the vitamin A fortificant (see Section 2.1.3 below).)

For those who had counted on protein fortification to be an important weapon against childhood malnutrition in developing countries, the results were surprising and disappointing. For the growing numbers who had felt that protein had been overemphasized, the results were vindicating. However for the millions

of stunted and wasted children in developing countries who could have benefited if the trials had been successful, the results were a terrible setback. The opponents to protein fortification had maintained that the solution to malnutrition was to provide more food, not just more or better protein -- regrettably these critics of the protein movement had no practical proposals by which to implement their solution on a broad scale and the children of the world are still awaiting an answer.

2.1.3 BREEDING AND FORTIFICATION COMMITTEE

PURPOSE

In 1970, the Office of Nutrition sponsored a workshop to explore how the techniques of plant breeding and food fortification might be applied to improve the protein quality of cereals. Assistance in the organization of the workshop was provided by FTB. One of the recommendations of the workshop was that a committee on breeding and fortification be established. The purpose of the committee was to explore how A.I.D. could encourage research and other actions to improve the quality of cereals through both the breeding and fortification routes.

PROCEDURES AND ACCOMPLISHMENTS

A committee was formed which was co-chaired by the Directors of the A.I.D. Offices of Agriculture and Nutrition. Membership included individuals from both the university research community and private industry. A member of FTB acted as executive secretary to the committee. The committee provided a forum for consultation and coordination between the two A.I.D. offices. Further, through participation of its members, the committee provided expert information on latest developments in the breeding and fortification fields as a basis for planning and coordination. The committee constituted an unusual example of a

mechanism for consultation and coordination between two A.I.D. offices engaged in complementary activity.

The model represented by the breeding and fortification committee could be profitably followed in other areas in which close coordination is required, such as activities in health and nutrition which might bear on the work of the Office of Health as well as that of Nutrition.

2.1.4 VITAMIN A FORTIFICATION

PURPOSE

For many years, vitamin A deficiency has been recognized as a nutritional problem in developing countries, particularly in rice eating areas such as Bangladesh, India, and Indonesia, but also in a number of other countries on all the continents. The problem was initially associated specifically with adverse effects on the eyes. Vitamin A deficiency was known to result in thousands of young children becoming blind each year. A.I.D.'s Office of Nutrition supported a number of projects to better define the scope of the problem, and to undertake interventions to overcome the problem. In addition, in the mid-1970s, Office of Nutrition activities led to the establishment of the International Vitamin A Consultative Group (IVACG), the leading international organization that works to develop and implement interventions to overcome vitamin A deficiency.

The importance of vitamin A as a factor effecting nutritional health took on new meaning in the early 1980s when reports from Indonesia suggested that even moderate vitamin A deficiency could cause higher mortality and morbidity in young children. The results of an A.I.D. sponsored study of the distribution of periodic massive doses of vitamin A through vitamin A capsules concluded that in areas where vitamin A deficiency is a significant problem, like Indonesia, that

improved consumption of vitamin A alone, can lead to substantial reduction of morbidity and mortality. While these conclusions have not been fully substantiated by other comprehensive studies, and some members of the nutrition community are skeptical, A.I.D. acted quickly to try to obtain further information from additional field tests that could confirm or deny the Indonesian studies, and simultaneously, A.I.D. launched a program to support vitamin A intervention activities in those parts of the world where the deficiency was known to be a problem.

During the entire period of A.I.D.'s interest in vitamin A, FTB has supported the A.I.D. program through projects aimed at utilizing food fortification as an intervention. FTB activities intensified in 1985 when Congress earmarked special funds for support of vitamin A interventions in developing countries. A.I.D. administered these funds and allocated a total of $850,000 during the period 1985-89 for FTB to use to assist private voluntary organizations develop and implement vitamin A interventions programs based on food fortification. The major activities of FTB related to vitamin A fortification are outlined below. In addition to these activities, FTB made inputs to a number of other programs which involved vitamin A fortification as an element of a broader intervention (see Section 2.7, Low-Cost Extrusion Cooker and Section 2.13, Child Survival Catch-Up Foods).

PROCEDURES AND ACCOMPLISHMENTS

The following paragraphs outline several of the vitamin A fortification projects in which FTB assisted A.I.D. clients.

Tea Fortification, Pakistan

In the early 1970s, as a result of special interests in nutrition by USAID/Islamabad, the GOP undertook to explore a number of new nutrition interventions. One potential intervention was the use of vitamin A fortified tea.

The fortification of tea with vitamin A had been studied in India through collaboration between the GOI, USAID/Delhi, and Hoffmann-LaRoche, a major supplier of synthetic vitamin A. That study showed that tea could be fortified by spraying an emulsion of vitamin A on the surface of tea leaves during processing, and that tea brewed from fortified leaves retained its potency even after an hour of boiling. The flavor of the tea brewed from fortified leaves was not altered in any way. USAID wished to examine the applicability of this technology to overcome vitamin A deficiency in Pakistan, which had been identified as a problem earlier through the GOP Nutrition Survey of West Pakistan, 1965-6.

USAID/Islamabad requested technical assistance from FTB through the A.I.D. Office of Nutrition to study tea fortification in Pakistan. FTB concluded that tea fortification appeared to be technically feasible, and that if tea fortification were implemented it could have a significant impact on nutritional health. FTB noted that the chief problem with tea fortification was absence of support among the major tea blending companies (Lipton and Brooke Bond). FTB recommended that the USAID support adaptation of the Indian technology and proceed with development of a project (1.2). The USAID accepted FTB's recommendations and the Office of Nutrition provided funding to adapt tea fortification technology to Pakistan's requirements and help the USAID develop a project paper.

In 1973, FTB adapted the Indian technology to Pakistan by developing procedures to spray a vitamin A emulsion on imported tea during the tea blending operations practiced by commercial tea blenders. The process was identified by International Venture Research, Chaska, Minnesota, through a USDA contract and transferred to Pakistan by providing a pilot-scale fortification system (1.3). After demonstration of the technology in Pakistan, FTB assisted the USAID draft a Project Paper to implement tea fortification as a national program.

Although the GOP and tea blenders became interested in the project, the USAID withheld approval until additional data could be collected through new studies of food consumption patterns and nutritional status. These studies were to have been carried out through a USAID-supported nutrition planning project managed by MIT contractors. Regrettably, the studies were never completed and the tea fortification project lost momentum which was never recovered. GOP planners, however, tried to expedite implementation of tea fortification without USAID support and, with the participation of Ispahani, a minor tea blending company, undertook field trials of vitamin A fortified tea in a limited marketing area using the pilot equipment supplied by FTB. The results of the trials were not shared with the USAID.

The Pakistan tea fortification project failed but reinforced an important development lesson -- that project momentum is crucial and if project planners and implementers wait to dot all the eyes, they will most certainly endanger the outcome of their efforts. Reducing risk of making errors in judgement by collecting substantial additional data can, and often does, increase the risk of losing the project because of the inherent delays and loss of momentum that accompany data collection and analysis. In an A.I.D. environment, where personnel and "project champions" come and go every 2-4 years, maintaining momentum is particularly important.

The project also illustrated the sensitivity of commercial companies about activities that could jeopardize markets for their products. Commercial food companies rightfully expect that fortification of their products must not adversely effect the consumer acceptance, and that this acceptance must be demonstrated to their satisfaction before they will cooperate. The testimony of a government bureaucrat or outside consultants that "everything will be just fine" is not generally persuasive to commercial decision makers.

Vitamin A Fortified Wheat, Bangladesh

Vitamin A deficiency is a serious nutritional problem for the people of Bangladesh with close to one million people suffering eye problems and about 30,000 blinded each year from severe vitamin A deficiency. With technical assistance from FTB, Helen Keller International (HKI) studied fortification as a way to reach the poorest of the poor. These activities started in 1986 and continued through 1988. In 1986, FTB examined various foods consumed in Bangladesh and identified the wheat distributed to low-income families through the Vulnerable Group Development program (VGD) and Food for Work (FFW) as a suitable vehicle (1.4). This wheat was found to be consumed by 20-25 million persons, nearly one quarter of the population.

Subsequently FTB assisted HKI local contractors carry-out a feasible study which concluded that it is technically and logistically feasible to fortify whole wheat by adding a US-supplied premix of concentrated vitamin A attached to wheat grains to regular wheat at grain storage silos in Bangladesh (1.5, 1.6, 1.7). FTB worked with the Wright Enrichment Co. of Crowley, Louisiana to develop the technology to produce the premix, which is called Vitamin A Wheat Concentrate. Laboratory support for this development was provided by the FTB cooperators at the Department of Food Technology at Iowa State University. The Vitamin A Wheat

oncentrate was designed to be used by mixing one part of concentrate with 400 parts of regular wheat to provide about 10,000 IU of vitamin A per Kg. of fortified wheat. In Bangladesh, whole kernel wheat is ground to meal (atta) and the atta made into a dough and baked to make flat bread (chappatis).

The technology development activities included testing of the stability of vitamin A in the fortified wheat, the meal, and the chappatis as used in Bangladesh. These products were produced in Bangladesh using vitamin A Wheat Concentrate produced by Wright Enrichment Co. and the vitamin A stability determined by testing both in Bangladesh and at ISU. The vitamin A stability was found to be adequate for the test conditions which duplicated expected conditions of use in the proposed programs (1.8). HKI, with assistance from FTB, designed a wheat fortification demonstration project which was to involve fortifying 30,000 tons of wheat per year and would reach about five percent of the 20-25 million VGD and FFW recipients in Bangladesh. The purpose of the project was to demonstrate technical feasibility and confirm nutritional impact. FTB provided the engineering layout for a fortification system, equipment requirements, recommendations for product handling and distribution, and a quality assurance program (1.9). The proposal was endorsed by USAID/Dhaka, preliminarily approved by the Bangladesh Institute of Public Health, and funded by A.I.D./W (1.10). Unfortunately HKI was unable to secure final GOB approval. While HKI tried hard to obtain approval, it was unable to get either an approval or an explanation and, in 1988 HKI abandoned the proposed project.

Although implementation of the Bangladesh demonstration project did not occur, several worthwhile accomplishments resulted from the effort. Foremost of these was the development of a new technology for the vitamin A fortification of whole kernel wheat and the preparation of specifications for the Vitamin A Wheat

Concentrate. Also, a comprehensive plan was developed for a food fortification intervention based on vitamin A fortification of whole wheat.

It seems reasonable that USAID or a suitable PVO reapproach the GOB to explore interest in wheat fortification. The technology for vitamin A Wheat Concentrate could have application in other countries of Asia where whole kernel wheat and whole meal flour are used as common foods or by selected target groups.

Monosodium Glutamate (MSG) Fortification, Indonesia

The A.I.D. Office of Nutrition supported an extensive survey of vitamin A status of children in Indonesia during the late 1970s which documented that vitamin A deficiency is a serious problem throughout the country. The study, which was supported with technical assistance from Helen Keller International (HKI), revealed that half of all preschool children do not consume enough vitamin A and that over 50,000 annually are afflicted with severe, potentially blinding xerophathalmia. Of perhaps greater importance, follow-up Indonesian studies suggested that even moderate vitamin A deficiency may contribute to higher mortality and morbidity among children in developing countries.

In 1979, the GOI and HKI requested technical assistance from FTB to advise them about the feasibility of using fortification as an intervention to reduce vitamin A deficiency among young children. After studying available information, FTB advised that fortification of MSG was a potentially viable intervention and outlined a program to examine feasibility and develop a program (1.11). The GOI accepted FTB's recommendations and during the next 10 years FTB continued to advise and provide technical assistance to the GOI.

FTB's major contribution was the development of a new technology to fortify MSG with enough vitamin A to provide one-half the recommended dietary allowance of

vitamin A to children consuming MSG. The technology enables manufacturers to fortify MSG by simply mixing MSG with a special "white" vitamin A produced in the U.S. that will neither discolor the MSG nor separate from it physically during handling and shipping (1.12). The process was developed by FTB cooperators at Iowa State University working with Coating Place, Verona, Wisconsin with support from FTB.

In 1985, the GOI undertook a field trial of MSG fortification in rural villages in East Java. During the year long study, fortified MSG was sold commercially to 30,000 villagers and unfortified MSG to an equal number in matched villages. The results showed that in those villages where fortified MSG was sold, vitamin A deficiency was erased as a public health problem whereas in the control villages, there was no change. In addition, mortality rates among preschool children dropped from 31 per thousand to 17 per thousand, a reduction of 45% (1.13, 1.14). The fortified MSG was found to be acceptable among users. The MSG manufacturer, PT Sasa, which closely monitored the field trial of their product, concluded the product was sufficiently similar to unfortified product that it was acceptable for general sales.

The outcome of the Indonesian field trial was a Letter of Decision issued by the Ministry of Health in April 1987 specifying that the MSG sold in packages used predominately by the rural poor would be fortified with vitamin A. Currently the GOI, with assistance from HKI and support from A.I.D., is mounting a program to implement the Letter of Decision 1/.

1/ NOTE: At the time of preparation of this report, HKI in Indonesia has reported technical difficulties with white vitamin A. The problem appears to be loss of integrity of the white vitamin A after prolonged exposure to Indonesian marketing conditions. HKI is consulting with ISU and Coating Place to try to find a solution to the problem.

At this time, the GOI has not yet reached a final decision concerning how the roughly $5 million per year costs for fortification will be paid. A number of plans have been suggested but it seems likely that the solution will be to increase the price of all MSG (not just the fortified MSG) in order to raise funds with which to pay the additional costs of the fortified MSG. Since roughly 2/3 of Indonesian MSG will not be fortified, the increase in price of fortified MSG will be relatively small. At the same time, since all MSG will increase in price, there will be no adverse price incentive to drive consumers of fortified MSG to use unfortified product.

The nearly ten year period between the time the GOI initially considered fortification until the Ministry of Health decided to proceed with fortification seems excessively long and was in fact much longer than the time required simply to collect information on which to base rational decisions. Actually much of this time was spent in debate about various political and technical issues. The Indonesian policy of requiring a consensus before action is taken and the resistance of various groups (including the Consumer's Union and the MSG manufacturers) to use of MSG as a fortification vehicle occupied much of the time. Considering the fact that during this time children were continuing to go blind and die because of lack of vitamin A, the process was hardly a desirable one. Nonetheless, the realities of the situation are that it takes a substantial amount of time to move projects from concept to implementation, regardless of the "sense of urgency" felt by the prime movers.

Vitamin A Cost-Effectiveness Analysis

Food fortification is one of the major options for alleviating vitamin A deficiencies in developing countries. Periodic distribution of massive doses of vitamin A capsules, and changing food consumption practices to include vitamin A rich foods are the other major options. However it has not been clear which of

these alternatives or which combination is preferred. In order for A.I.D. to have a rational basis for recommending fortification or one of the other options as the intervention of choice, A.I.D. requested FTB to study the cost-effectiveness of alternative vitamin A interventions and offer recommendations concerning procedures for selecting the preferred intervention.

In 1985, FTB entered into a cooperative agreement to support the University of Michigan to study cost-effectiveness of alternative vitamin A interventions. The agreement provided support to develop computer models for evaluating alternative interventions and predict costs and nutritional impact of capsule distribution, food fortification and changing food practices. It also called for Michigan to present recommendations for use of the models and to suggest additional work to improve the models. The University of Michigan was provided with a comprehensive scope-of-work for their activity which had been developed jointly by an advisory group with representatives from A.I.D., USDA, the World Bank, Johns Hopkins, and other centers of expertise on the subject (1.15).

The University of Michigan developed cost-effectiveness models using general information from the literature and specific information from Indonesia as a basis for establishing both costs and effectiveness. The model was constructed for use with dBase III and a computer program and Users Guide were developed (1.16). Results of analyses made using the model together with recommendations for application of the model were submitted to A.I.D. and USDA as a draft report (1.17).

The Michigan report compared the costs and effectiveness of alternative interventions and concluded from an illustrative case based on Indonesia that when

very low levels of program expenditures are made, diet modification is the preferred intervention, while at intermediate levels of program expenditures, capsule distribution is the most cost-effective. At high a levels of expenditure, over $0.10 per person per year, fortification is preferred.

FTB's assessment of the Michigan study concluded that the Michigan model was not a suitable basis for selecting among alternative interventions because of the large uncertainty of predicting health effects of the various interventions.

However FTB suggested to A.I.D. that it support additional work to better understand the outcome of implementing interventions and to provide a better basis for not only making selections among alternative approaches but to predict better the outcome of A.I.D. supported activities (1.18).

Research and Development, Iowa State University Cooperative Agreement

As noted above, special earmark funds for vitamin A interventions led to a speed-up by A.I.D. of the implementation of action programs for vitamin A introduction worldwide. A.I.D. requested FTB to work with USAIDs, PVOs, etc. to help identify foods for fortification, to develop fortification technology when needed and to assist in the transfer of technologies to the selected developing countries. It was anticipated that there would be a need to develop new technologies for fortifying foods not commonly fortified such as MSG, salt, condiments and whole kernel wheat. Therefore FTB and A.I.D. saw a need to establish a base for support which would include a facility that had proper equipment, personnel experienced with vitamin A analysis and technology development, and staff capable of handling the expected workload.

Evaluation visits were made to several universities as candidate sites to establish this base for support. Iowa State University was selected as best meeting these requirements and a cooperative agreement was established with the Department of Food Technology in 1985.

Over a period of four years, a variety of activities was undertaken at ISU. Foremost among these activities were the development of "white" vitamin A preparation for use in fortifying MSG in Indonesia, the development of the technology for fortifying whole kernel wheat in Bangladesh, and the development of techniques for adding vitamin A to simulated rice kernels and to "moist" salt.

The developments with "white" vitamin A and with whole kernel wheat are covered in detail as separate reports appearing in this section on Food Fortification.

The ISU activities were carried out by a core staff of 3-4 scientists and technicians supplemented occasionally by consultants from the Department of Home Economics and Nutrition and the Department of Biochemistry at ISU. Several thousand vitamin A assays were done in studies of the stability of vitamin A under a range of conditions of temperature, humidity etc. as part of the technology development. This was related to the use conditions expected to be encountered by vitamin A preparations and fortified foods. This has resulted in a skill base for knowledge of vitamin A properties and for technical support for vitamin A food fortification programs.

The initial cooperative agreement with ISU included technology development as part of the activities. However, this area wasn't pursued as a major area of activity because of personnel changes at ISU and because ISU was using its resources to assist technology development that was being spearheaded by commercial sector companies including Wright Enrichment Co. for wheat and rice fortification, the Coating Place for "white" vitamin A, and the Bon Dente Co. for extruded simulated rice kernels.

Among its activities, ISU tested rice kernels prepared by Wright Enrichment Co. that were fortified with vitamin A using a coating technique like that used for wheat. Unfortunately, the product did not have adequate cook resistance and storage stability. This led to an activity with extruded simulated rice kernels made by Bon Dente Co. The outcome of this work was a simulated rice kernel witn extremely low loss during cooking and good storage stability. This product will be made available to the researchers at the Food and Nutrition Research Institute in the Philippines for use in a fortified rice project.

Numerous small studies were carried out during the agreement period which provided basic information and/or helped advance the technology development. For example, the stability of regular commercial vitamin A preparations was tested alone and by blending the preparations with dry and wet (3.5% moisture) salt and storing it under various conditions of temperature, humidity and light. A modification of this was used in testing the lipid protected vitamin A preparations made by Durkee Foods and Balchem Chemical Co. Those preparations showed considerable protection against vitamin A loss up to a relatively high moisture level (about 2%) in salt. This information may be the basis for development of an intervention for the vitamin A fortification of moist salt.

The cooperative agreement also had provisions for contracting experts when needed for overseas technical assistance. A process engineer was sent to HKI/Bangladesh to establish a fortification system and quality control procedures for the fortification of whole wheat. Also, a consultant was sent to USAID/Haiti to review vitamin A programs and to check the feasibility for food fortification interventions using vitamin A technology. In addition, the services of Pat Murphy, Principal Investigator, and Harlan Hall, Coating place, were provided to HKI/Indonesia in regard to product quality and vitamin A stability problems which have arisen recently.

2.1.5 IRON FORTIFICATION OF WHEAT FLOUR, EGYPT

PURPOSE

During the mid 1970's to mid 1980s, the A.I.D. Office of Nutrition gave special emphasis to micronutrient deficiencies and to efforts to overcome iron deficiency anemia in developing countries. As noted previously, one of the activities was the formation of the International Nutritional Anemia Consultative Group (INACG) to help coordinate LDCs and donor agencies who are working to reduce iron deficiency anemia. Another Office of Nutrition activity was to provide technical assistance to USAID's and host country government institutions for developing and implementing programs that address iron deficiency anemia. FTB became involved in certain of the programs which studied food fortification techniques. FTB participated in feasibility studies and in the planning of nutrition interventions using food fortification. Several examples of such participation include activities in Lesotho, Philippines, Jamaica and Egypt.

In Lesotho, a major workshop was planned and put-on by FTB in cooperation with USAID and the GOL. The workshop addressed the technology for adding iron and certain vitamins to cornmeal, the basic staple food of the country. Follow-up information indicated that vitamins were being added to cornmeal but iron addition had not yet been initiated.

In the Philippines technical assistance was given to the Philippines Food and Nutrition Research Institute regarding the development of technologies for adding iron to rice.

In addition, the feasibility of using cornmeal, and fish sauce, and fish paste as fortification vehicles was studied. In Jamaica the feasibility of adding increased amounts of biologically available iron source to cornmeal and wheat flour was studied and a program outlined as to how this could be done using existing Jamican processing facilities.

PROCEDURES AND ACCOMPLISHMENTS

The most extensive participation of FTB in iron fortification activities was in Egypt. Iron deficiency anemia was known to be widespread and represented a serious public health program in Egypt. In the early 1980's, scientists in Egypt conducted studies that demonstrated that the anemia present in Egypt responded to iron therapy and that a daily intake of a modest level of iron can improve iron status. USAID/Cairo offered assistance to the GOE for the planning and implementation of programs for combatting anemia. The strategy included several alternatives including food fortification as a way to increase the iron in the daily diet. The GOE decided to look into the feasibility of fortifying wheat flour with iron.

Wheat flour in the form of breads and pasta is universally and heavily consumed in Egypt and could serve as a good vehicle to carry additional iron into the diet. The GOE sought USAID assistance in developing a National Fortification Program based on fortification of wheat flour with iron.

FTB prepared a discussion paper on fortification for USAID/Cairo in 1983 and then Fred Barrett visited Egypt to study the feasibility for iron fortification of wheat flour. The study was positive both from a technological standpoint and for the likelihood of a positive effect on improving the iron nutritional status of the people of Egypt (1.19)

In 1983, an Iron Deficiency Anemia Workshop was held in Cairo for the purpose of developing a national strategy for combatting anemia. FTB's Barrett served as a major resource person (1.20).

The strategy resulting from the workshop included continued planning of a program for iron fortification to be completed in phases, first on a limited scale and then on a national coverage basis.

Through 1984 USAID/Cairo along with the A.I.D. Office of Nutrition, continued to discuss a project proposal for iron fortification. This resulted in the convening of a planning workshop held in Washington attended by personnel from USAID, the GOE, FTB and A.I.D. It was agreed at this workshop that a Project Paper should be prepared for a national program to fortify wheat flour with iron and the paper used as a basis for GOE and USAID decisions re. implementation of the program. In March 1985 FTB's Rod Crowley visited Cairo and worked with USAID to write the project paper (1.21).

The USAID and GOE were actively involved in drafting the Project Paper and it appeared likely that it would be accepted and implemented. However, on the last days of that TDY Jim Cook, consultant to the Office of Nutrition regarding iron, visited Cairo and during key meetings questioned the safety and the potential effectiveness of iron fortification and raised concerns about the suitability of the iron fortification of wheat flour without elaborate field tests. This caused the principals in Egypt to put a hold on further development of the flour fortification activity and essentially stopped the project.

Concurrent with the above activities, arrangements were made by USAID/Cairo to utilize $200,000 available in HHS Joint Working Group funds for the design and implementation of a pilot project for iron fortification. HHS, under the leadership of FDA's John Vanderveen, proceeded to design a limited field trial.

To date, iron fortified flour has been provided to orphanage children and in 1990 it is expected that two flour mills will be equipped to produce iron fortified flour on a commercial scale as part of the pilot study.

FTB has always believed that iron fortification of wheat flour in Egypt is a worthwhile intervention and should be pursued to a successful implementation of an operating national program. USAID/Cairo should provide financial support and technical assistance to the GOE to help ensure successful completion of the pilot program and, if successful, the national program. At the appropriate time, U.S. equipment manufacturers, premix suppliers, and technical advisors should be made available for planning, installation, and start-up of the fortification aspects of the iron fortification program.

2.1.6 SALT IODIZATION, PAKISTAN

PURPOSE

Iodine deficiency disorder, as a serious nutritional problem of the developing world, has been dealt with principally by UNICEF while A.I.D. has focused its resources on the solution of other problems. However in 1972, USAID/Islamabad investigated salt iodization along with other fortification options which might be practiced in Pakistan. The outcome of the study was the conclusion that salt consumed by people in high risk areas, such as the Himalayan foothills, could not be iodized because it was unground rock salt for which no fortification technology existed. Later, in 1974, it was found that Pakistani enterpreneurs were grinding rock salt and packaging the ground salt in polyethylene bags for sale in the high risk areas. USAID believed that this change in local practice might serve as basis for salt iodization and requested technical assistance from FTB to study feasibility and make recommendations for follow-up.

PROCEDURES AND ACCOMPLISHMENTS

In 1976, an FTB consultant, Mr. Ed Willse, a retired Morton Salt technologist, traveled to Pakistan to assess the feasibility of fortifying ground rock salt with iodine. Willse concluded that the process used by the existing enterpreneurs did not lend itself to fortification because the small one-man grinding mills could not be adequately controlled to assure proper fortification. However he noted that a larger scale operation, using multiple grinders under unified management and supervision, could be built and iodization equipment installed and properly controlled. Willse designed a facility of this type using Pakistani equipment and delivered the design to the USAID. Subsequently USAID discussed Willse's proposal with UNICEF and the GOP and it was agreed that the new salt grinding and iodization factory should be built. Eventually UNICEF supported installation of the factory in Peshawar and iodized salt was delivered to the at risk population living in the Himalayan foothills in the Northwest Frontier Province of Pakistan.

2.1.7 RECOMMENDATIONS

Food fortification can be one of the most powerful direct nutrition interventions available to developing countries. As outlined above, it can be used to reach many of world's poorest-of-the-poor, even in remote rural areas. Because commercial food distribution has been extended almost universally throughout the world, and therefore fortifiable processed foods are found essentially everywhere, fortification need not be thought of solely as applicable to urban populations. In today's world, fortification is perhaps as universal an intervention as any of the major programs contemplated by nutrition planners.

The U.S.G. has publicized fortification as an important approach to malnutrition in developing countries and, through the PL 480 Food for Peace program, has

distributed fortified food commodities around the world. Also A.I.D., with the active involvement of FTB and its many other support organizations, has promoted food fortification actively. However with all these activities, few fortification programs have actually been implemented in developing countries.

The reasons for inadequate application of this important approach appears to be twofold. First there appears to be insufficient funding available to local governments to pay readily the recurring costs to implement fortification programs. Second, there is a strong desire among nutrition planners, both those with local governments and with the donor agencies, to prefect all the aspects of potential impact, coverage, alternatives, etc. before proceeding with a specific program activity. This process of searching for the optimum solution to a problem is obviously intended to lead to better utilization of resources. However its over zealous application can and often does result in long delays and sometimes total lack of implementation of programs of any type.

Tne problems of (1) lack of resources and (2) the aspirations of planners to make error free judgements are obviously not easy to overcome. However these problems have been overcome in the PL 480 Food for Peace program where U.S. donated commodities have been fortified with vitamins, minerals, and proteins for over twenty years and distributed to millions if not billions of needy persons in developing countries. The costs are borne by the people of the U.S. by the decision of the U.S. Congress because Congress believes this is a good use of resources. Therefore it's clear a political decision can be made to expend major resources to implement a fortification program without knowing all the details in advance. The decisions as to the amounts and types of fortificants have been reached through reasoned judgements by representatives of USDA and A.I.D. The judgements aren't necessarily perfect and the system is flexible enough to permit change when new information becomes available. Interestingly,

local governments using the commodities have never, to FTB's knowledge, questioned the amount and type of fortificant used in the commodities donated by the U.S.G. This implies that if the commodities are available without cost and the decisions are made through a reasoned but expeditious process, fortification can be implemented quickly without great controversy and would probably be acceptable to local governments.

A possible solution to the problems is to encourage the formation of an international fund to support food fortification programs in developing countries and and to establish management of the fund by persons who have not only a desire to solve international nutritional problems but have a strong sense of urgency. It is recommended that A.I.D. explore the formation and management of such a fund.

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2.2 COMMERCIAL FOODS GRANTS

2.2.i INTRODUCTION

In the late 1960s, USDA proposed a new approach to nutrition interventions for A.I.D. to consider. Up to that time, nutrition had been approached mainly through public health activities such as nutrition education and child feeding programs. In contrast, the proposed new program sought to make use of private food manufacturing companies as a means of improving the nutritional status of needy populations. The outcome of the proposal was the A.I.D. Commercial Food Studies Program which made incentive funding available to U.S. companies to develop and market test low-cost, nutritious foods. Subsequently in 1971, a second program was initiated which provided similar funding to developing country food companies. The two programs are described below.

2.2.2 HIGH-PROTEIN FOOD STUDIES PROGRAM

PURPOSE

The purpose of this program was to encourage U.S. food companies to develop and market high-protein, low-cost foods to meet the needs of developing country populations. At the time, nutrition experts viewed lack of protein as the most important problem to be addressed by a nutrition program. And for this reason the program emphasized distribution of nutritious foods which were particularly high in protein. The objective of the new program was to get U.S. companies to become involved in a new, high-risk market. The program was designed to help them to adapt their technology to produce low-cost nutritious foods and to seek a market for such foods among consumers who were very different from those with whom they had experience in the U.S.

PROCEDURES AND ACCOMPLISHMENTS

A program to provide incentive funding to U.S. companies to develop, or adapt, and market test high protein food products was developed by Aaron Altchul of USDA, working in partnership with Dan Rosenfield of A.I.D.'s Nutrition Office. (At the start of the program in 1967, Dr. Altchul was a member of the staff of a larger USDA unit which was supported by A.I.D. When the present food technology office was funded under a PASA in 1968, Dr. Altchul became its first director where he continued his involvement with this program. At this time, Dr. Rosenfield also joined USDA and became a member of FTB.)

The program used an approacn which was new to A.I.D. at that time. This was incentive funding, other than of research, to encourage an organization to engage in an activity which would further A.I.D. interests but which the organization would not normally have undertaken on its own. A program for preinvestment feasibility surveys was then in existence which returned 50% of the survey's cost to companies which decided not to invest. This existing program, however, was for more traditional investments with much clearer likelihood of success. Through the new A.I.D. program, U.S. companies were being asked to do something new -- to attempt to market a low-cost nutritious product which would reach and help alleviate malnutrition among low-income populations. And, on the basis of contacts with over 80 companies it was concluded that what was needed to interest companies to enter this high-risk area was a greater incentive which covered full rather than partial market survey and test marketing costs.

Under the program, U.S. companies were invited to submit applications which were reviewed by an advisory panel. Contracts of $60,000 were entered into with qualifying applicants. A three phase approach was established which consisted

of a study of food habits and nutritional needs, product development or adaptation, and market testing. The first and third steps were funded by the contracts (2.1).

Between 1967 and 1969, 14 contracts were entered into with U.S. food companies. Major companies participating in the program included Pillsbury, Swift, General Foods, Monsanto, and others. Market surveys were conducted in Latin America, Asia and Africa. Products included high-protein beverages, enriched pastas, fortified couscous, enriched corn flour, milk-corn gruel, textured vegetable protein products, and a cottonseed protein concentrate.

The program resulted in the active involvement of the U.S. food industry in the problem of overseas malnutrition and in the development and testing of a number of innovative products. As a part of this effort, the compainies contributed their own funds in amounts which were estimated to be at least equal, if not exceeding, the funding provided by A.I.D. As a resut, the program demonstrated that incentive funding could be used successfully by A.I.D. to encourage organizations to enter a new area and take action where they might otherwise not. Later, in 1968, A.I.D. used this same approach to provide incentive grants to Private Voluntary Organizations (PVOs) to encourage them to add nutrition education components to feeding programs which at that time often lacked this componenet. The Agency now has a very large program of grants to PVOs. The program of incentive funding for U.S. companies also provided a model for a similar program for developing country food companies initiated in 1971 as will be discussed below.

While the program achieved the objective of getting U.S. companies to adapt their technology for the development of products to alleviate malnutrition and to market test these products, none of the efforts resulted in the permanent introduction of a new product. In general, it was found that the companies were

able to solve the technical problems of designing a food that was botn nutritious and acceptable. But creating a market of sufficient volume to justify an overseas investment by a U.S. company remained much more of a problem.

This marketing problem should be viewed against the fact that in a U.S. market a company typically develops and market tests a large number of products before identifying one that is a financial success. A 1971 review of the program by FTB (2.2) also suggested several actions which the authors felt might improve the possibility of successful introduction. These actions were (1) to take advantage of an already known brand name if possible, (2) to select a product requiring a relatively small plant size so that volume would not have to be very large to permit reasonable unit costs, and (3) to have some type of government institutional market so as to guarantee a demand large enough to justify initial start-up costs.

2.2.3 GRANTS TO LDC FOOD COMPANIES

PURPOSE

In 1971, the Office of Nutrition initiated a second activity which was similar to the High Protein Studies Program for U.S. companies, but was directed instead to developing country companies. The objective was to encourage local LDC companies with established competence in food production and marketing to develop and introduce products which could help improve the nutritional status of low-income urban and rural populations.

PROCEDURES AND ACCOMPLISHMENTS

A program was established which made available grants of $30,000 to developing country food companies for feasiblility studies. The purpose of the studies was to analyze potential markets, products, and raw material availability, to obtain

technical assistance, or to conduct test marketing (2.3). Proposals were submitted through A.I.D. missions and reviewed by an AID-USDA committee organized and chaired by FTB.

A total of six grants was made. The grants were awarded to three companies in Korea, two in Nigeria, and one in the Philippines.

In Korea, the Sam Yang Company developed and tested a soy fortified noodle. A soy fortified cookie was devleoped by the Tong Yang Company, and a soy enriched bread was developed and market tested by the Sam Lip Company. In Nigeria, the ICR Company marketed a repackaged Corn-Soy-Milk product. In the case of the other two grants, feasibility studies led to a decision not to market test a product; in the Philippines case, the decision was due to problems in identifying a suitable protein source, and in Nigeria, the Hossco Co. decided against moving forward on business grounds.

In general, the experience in this program bore some similarity to the program for U.S. companies. Products which were nutritious and acceptable were created, but none of the companies concluded they could develop a market where the consumer would pay more for a nutritious product. These products were, for the most part, directed to the general consumer rather than a particular vulnerable segment.

The case of the Sam Lip Company underlines this experience. As described in the section of this report on Nutritionally Improved Wheat Flour (2.6), Sam Lip was able, with additional technial assistance, to produce a soy fortified bread at the same cost as its regular bread. When this enriched bread was introduced in a test market at the same price as regular bread, it sold as well or better. However because the soy fortified bread was not price-controlled, the bakery

company decided to try to sell it at a higher price than it regular bread. It was only at this point, when the market was asked to pay more for nutrition, were difficulties encountered in achieving a large enough share of the market to justify an investment.

2.2.3 RECOMMENDATIONS

The two incentive granvate sector as one of the means of improving nutrition. While these initial efforts were not themselves successful, efforts that have followed have been. In the future, use of commercial channels should continue to be considered as one tool for alleviating malnutrition and selected whenever appropriate.

In general, low-cost commercial unsubsidized food products can be expected to be consumed by even low-income families but probably not by the very lowest income groups or by the destitute. Therefore these products should play a role in providing better nutrition to large numbers of children in LDCs. At the same time, the products can reach children in very great need, those who are already malnurished, through use of a food stamp approach. This approach is described under the section of the report dealing with improving the impact of feeding programs (see Section 2.14).

2.2.4 REFERENCES

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(2.2) Rosenfield, D. and Weil, R., Analysis of the A.I.D. Commercial Protein Food Studies Program. USDA Special Report, April 1971.

(2.3) Bandle, M., Low-Cost Nutritious Food Development Grants for Local Food Processing and Marketing Organizations. AIDTO CIRC A-2423, Dec.30, 1971.

2.3 CHILD INTERVENTION COMPENDIUM

2.3.1 PURPOSE

One of the recurring problems which is faced in planning nutrition interventions is to select the approach which will be the most appropriate and cost effective for the conditions faced.

In 1972, FTB initiated a study to collect information on alternative nutrition interventions. The interventions included not only those of direct interest to FTB (such as fortified foods and food supplements), but also competing or complementary interventions (such as nutrition education). The purpose was to identify and analyze alternative interventions with view to learning more about what was available as a basis for selection.

2.3.2 PROCEDURES AND ACCOMPLISHMENTS

Information was collected by FTB staff through review of written material and interviews with those who were engaged in developing and implementing interventions. For each program included in the study, descriptive material was sought on how the program worked, who it reached, its nutritional effectiveness, its contribution to other development goals, and its cost.

The study resulted in a compendium of fourteen interventions. These included take-home and daily feeding programs, approaches which combined nutrition and health, and such approaches as fortification, use of mass media, and distribution of commercial foods. A table comparing costs and benefits was also prepared (3.1).

The study was a first attempt in this area by A.I.D. It lead to the Office of Nutrition commissioning an extensive project by Harvard University to develop a series of manuals, each devoted to a particular type of intervention (3.2). Each Harvard volume discussed in some detail experience with the approach, advantages and disadvantages, conditions under which it was appropriate to use it, and similar information.

2.3.3 RECOMMENDATIONS

Preparation of the FTB compendium led to the Harvard manual series which has provided helpful information on alternative interventions and has been widely used. However, since the Harvard series of 1981, considerable additional experience with development and implementation of nutrition interventions has been acquired. It is recommended that further information on the most effective interventions be prepared and disseminated by A.I.D. This effort might be linked to an operations research undertaking to further improve interventions (see Section 2.14).

2.3.4 REFERENCES

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(3.2) Austin, J.E. et al., Nutrition Intervention in Developing counties. Oelgeschalger, Gunn, and Hain, Inc. Cambridge, MA. 1981. (Reference not included in library collection.)

2.4 APPROPRIATE TECHNOLOGY

2.4.1 PURPOSE

The role of appropriate technology in general economic development has received considerable attention over the years. In 1978 and in 1989, at the request of the Office of Nutrition, FTB undertook studies to explore the possible application of appropriate technology for the alleviation of malnutrition.

In the 1978 study, the objective was to identify a small number of technologies which had potential to directly increase the availability of low-cost nutritious food. In the 1989 study, the aim was to identify specific technologies which would save women time in processing and preparing food in order to free up time which they might use to provide better nutrition care.

2.4.2 PROCEDURES AND ACCOMPLISHMENTS

In the 1978 study, FTB organized a team which consisted of three food technologists who had experience in small scale food technology. The team leader, Robert Bates of the University of Florida, was joined by Mark Sterner, a former Director of Meals for Million, and Teresa de Buckle, a member of the staff of a Colombian food technology institute. This core group was assisted by several consultants with experience in grass roots rural development work. The core group worked with the rural development specialists to analyze the food chain in order to identify weak links which might interfere with consumption of nutritious foods. This was done in order to then select technologies which could address the food-chain problems which had been identified. The group consulted with other experts in food technology and nutrition (4.1).

The FTB team identified five technologies which they felt held promise of making a contribution to nutritional status of vulnerable groups. These included, on

the one hand, home level approaches, such as adding salt and soda to bean cooking water to reduce the cooking time and encourage increased legume consumption. On the other, intermediate scale technologies were recommended, such as village level oil extraction devices. For each technology, the group prepared a summary Project Implementation Document to facilitate A.I.D. review and consideration of the approach (4.2). As a result of the study, the Office of Nutrition selected a proposal to develop a means of stabilizing rice bran and recovering edible rice bran oil. This activity is described in detail in the Section 2.7 of this report.

The 1989 study was conducted by two consultant, John Slavics, a food technologist who had formerly been a member of Appropriate Technology International, and Iris Ford, an anthropologist with a specialty in cooking practiced. Robert Weil of FTB also participated in the study.

U.S. based organizations which were considered leaders in the introduction of appropriate technology were contacted and members of these organizations were interviewed. This consultation was complemented by a review of literature pertaining to relevant technologies including references obtained from overseas appropriate technology groups. In addition, private voluntary organization personnel and other development experts were consulted to obtain suggestions regarding sites where the technologies which had been selected might be transferred.

The team identified seventeen technologies which were considered particularly promising or effective and therefore meriting consideration for more widespread transfer (4.3). The focus was on those food preparation tasks which are most time consuming with emphasis on Africa. For example, the study addressed the problem of hand grinding of sorghum and corn and the grating of cassava.

Technologies identified included village level mills to process grains, presses and extraction units to obtain oil from oilseeds, manual devices to shell corn and peanuts, and low-cost fuel efficient stoves to alleviate the task of firewood gathering. For each technology, the study included a description of the time consuming task which the technology had the potential to alleviate and an estimate of the time which the technology could save. In addition, the report suggested some specific sites where the technologies might be introduced and noted several private voluntary organizations which expressed interest in participating. The report discussed actions which the Office of Nutrition might wish to consider in follow-up. This included recommendation of a project to demonstrate the impact of labor-saving technology on improved child care behavior as a result of freeing up the mother's time.

2.4.3 RECOMMENDATIONS

Home and village level technology can be used to alleviate malnutrition in two different ways. The first, which was the focus of the 1978 study, is to directly increase the availability of low-cost nutritious foods. In this case, two actions are recommended: (1) that A.I.D. continue the adaptive research on solar cooking (see Section 2.10, Solar Box Cookers), and (2) that A.I.D. seek to identify additional high impact appropriate technologies that have been identified or developed since the 1978 report, e.g. malting as a way of reducing the viscosity and increasing caloric density of home prepared foods used for weaning.

In conducting a review of small scale technology as means of improving nutrition, it is important that the solutions identified be compared with central processing options. Since a key factor is cost in relation to effectiveness, the choice of a village processing approacn or a central processing option should be made on the basis of a comparison of relative costs and effectiveness.

The second way in which food technology may be able to improve nutrition is where it is employed as one contributor to a larger system of inputs where the aim is to simultaneously induce improved feeding practices and free time for their implementation. Thus, in the 1989 study, the objective was to identify technologies which could be used to alleviate the very substantial burdens of women and, as a result, help enable women to devote more energy to providing effective nutrition care. This approach appears to have promise and should be tested. As recommended in the second study, such a test should be carried out in conjunction with nutrition education. In this way the proposition that technology can make nutrition education efforts more successful could be tested. (The test should include a control group which would receive the education alone.) In addition, to a test of village level technology, however, it is believed that such a test of a "systems approach" should be expanded to also include use of centrally processed foods. Thus a centrally processed convenience food might simultaneously both save the woman time and facilitate improved intake.

2.4.4 REFERENCES

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(4.3) Slavics, J., Ford, I. and Weil, R.P., Labor Saving Home and Village Technology for Food Processing and Preparation. USDA Special Report. Sept. 1989.

2.5. WHEY-SOY DRINK MIX

2.5.1. PURPOSE

From time to time, U.S. agriculture finds itself producing far more milk than than the market can absorb. During those times, USDA has been required to purchase the surplus as a part of its price support program, and to then dispose of the surplus through its domestic and overseas feeding programs. In the 1960s and early 1970s, a prolonged surplus resulted in massive overseas distribution of milk powder in feeding programs. Millions of malnourished children in developing countries grew to depend on milk powder provided through the PL480, Title II Food for Peace Program. But in 1973, as a result of strong domestic and international demand, the surplus disappeared and milk powder was no longer available for overseas PL 480 distribution.

In the spring of 1973, A.I.D.'s Office of Nutrition requested FTB to search for an inexpensive substitute for milk powder that could be distributed to needy children overseas through the Food for Peace Program. A.I.D. requested that the product be suitable for reconstitution with water to make a milk-like beverage and that the beverage have nutritional qualities that would enable it to be used as a supplement for malnourished children in Food for Peace Programs overseas.

2.5.2 PROCEDURES AND ACCOMPLISHMENTS

FTB, working closely with USDA/ARS Dairy Products Laboratory scientists and representatives of the dairy industry, developed an inexpensive new beverage product, evaluated its nutritional properties and acceptability among overseas recipients, and initiated production in early 1974.

Nutritional requirements and specifications for the product were generated by an advisory panel made up of Samuel Foman (University of Iowa), George Graham (Johns Hopkins), and Gerald Combs (USDA/ARS). The panel recommended that the

replacement product should have nutritional qualities more like whole milk rather than nonfat milk, and that it contain a broad spectrum of vitamins and minerals similar to those used in the blended foods distributed through PL 480.

Based on previous research by ARS (5.1), FTB developed a formula using sweet whey, soybean flour, soybean oil, corn sugar, and vitamins and minerals that satisfied the panel's requirements. The formulation made use of sweet whey as an inexpensive source of food energy and milk-like flavor notes, soybeans for protein as well as to provide 20% oil to increase the caloric density, corn sugar as a sweetner, and 11 added vitamins and five added minerals. An FTB contract was given to Foremost Foods of Dublin, CA. to produce a test lot of the new product. The product was evaluated for nutritional quality and stability by ARS (5.2) and for acceptability among recipients in five overseas countries (Dominican Republic, Sierra Leone, Vietnam, Chile, and India) through an interagency agreement with DOD's Natick Laboratories (5.3) The tests showed the product to be highly satisfactory. USDA's Economic Research Service analyzed potential costs of the new product and concluded that it could be produced by U.S. dairies at a cost of $0.25-0.30 per pound, substantially less than the cost of milk powder (5.4).

In early 1974, within nine months after the request from A.I.D., USDA's Agricultural Stabilization and Conservation Service (ASCS) started procurement of the new product which they named Whey-Soy Drink Mix (WSDM). The product specification had been drawn up jointly with representatives of the U.S. dairy industry through cooperation between USDA and the Whey Products Institute (5.65. ASCS procured over 25 million pounds of WSDM during FY 1974-78 and shipped it to 14 countries overseas where it was used in child feeding programs supplied with PL 480, Title II food commodities. During 1975, an FTB consultant, Dean Wilding, visited Bolivia, Guatemala and other countries where WSDM was used and

reported that the product was well accepted and considered a successful substitute for milk powder (5.6).

Soon thereafter milk again became a surplus commodity in the U.S. and ASCS determined that milk powder rather than WSDM should be used in overseas feeding programs. Although production and distribution of WSDM ceased, the product can again be made available if it should ever be determined that a beverage-substitute for milk is required in food distribution programs overseas.

2.5.3 RECOMMENDATIONS

No additional work on WSDM is recommended. However the FTB experience in developing WSDM is a model which might be followed to create other nutritional products for use in public programs. The WSDM project demonstrated that government and industry can cooperate effectively within a short time span to create useful new products, and that market-oriented product development as practiced by the U.S. food industry, including a full range of product and consumer evaluations, is possible even within the constraints of a tight schedule. Elements of the process used to develop and evaluate WSDM ought to be used as a part of future efforts to generate new Title II commodities as well as to develop new products for manufacture within developing countries. FTB successfully used similar procedures in developing Cerex for Guyana and Thriposha modifications for Sri Lanka (Section 2.7), and had begun a similar process for the development of a new Catch-Up food (Section 2.13).

2.5.4 REFERENCES

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2.6 NUTRITIONAL IMPROVEMENT OF WHEAT FLOUR

2.6.1 INTRODUCTION

Wheat and wheat flour are major food staples in many developing countries. In the 1960s in early 70s, the A.I.D. Office of Nutrition sought ways in which wheat flour could be improved nutritionally so that it might be used more effectively to alleviate malnutrition. As a part of this effort, the Office of Nutrition sponsored research at Kansas State University to explore ways of adding soybean flour to wheat flour without adversely effecting the quality of bread made from the flour. Pioneering work by Kansas State scientists led to the identification of sodium steroyl lactylate (SSL) as a flour additive that permits addition of up to 12% soybean flour without loss in volume, texture, or color of bread baked from the flour. This discovery was utilized by USDA in the Food for Peace program starting in 1973 when large amounts of wheat flour procured for shipment overseas in donation feeding programs were fortified with 6% or 12% soybean flour and SSL was added to prevent loss of baking quality.

In 1974, the Office of Nutrition requested FTB to identify additional applications for the Kansas State technology. FTB undertook two activities to do so. The first was to develop demonstration projects to utilize the technology in Korea and El Salvador. The second was to develop and assist A.I.D. oversee a major project to identify countries where the technology could be used and to transfer the technology to those countries. The second project was implemented by USDA's Western Regional Research Center with funds provided through a PASA

with A.I.D. The following sections outline the two FTB-assisted activities aimed at improving the nutritional value of wheat flour using Kansas State University technology. 1/

2.6.2 SOY FORTIFIED BREAD DEMONSTRATION PROJECTS, KOREA AND EL SALVADOR

PURPOSE

FTB initiated a program in 1974 for carrying-out bread demonstration projects to implement a soy fortification technology which had been developed through A.I.D. supported research. The projects included the production and marketing of protein fortified bread products in Korea and El Salvador. The demonstration projects were intended to serve as models for the introduction of soy fortified bread products in other developing countries. FTB and A.I.D. expected the demonstrations to show technical and economic feasibility of manufacture and commercial sale of soy fortified products in competition with regular bread.

PROCEDURES AND ACCOMPLISHMENTS

The same pattern of project development and implementation was followed in each country with modifications as needed to fit the local conditions. Each country will be reviewed separately.

1/ The reader should bear in mind that at the time the Kansas State technology was developed and FTB initiated its activities to try to apply the technology, A.I.D.'s nutrition advisors believed that protein deficiency was the major public health problem facing developing countries. As knowledge grew, nutritionists changed position and concluded that lack of food energy was the major problem, and that protein supplementation without additional food energy was an ineffective action. Today public health planners give important consideration to energy, protein, and micronutrients. However protein supplementation of the diet of the general public is not accepted as a sound practice. It should be recognized, however, that nutritionists still have much to learn and it is conceivable that protein supplementation someday might again be advocated as an intervention for the general public.

Korea

The Sam Lip Foods Company, Inc. Seoul, Korea, had applied for and received an A.I.D. grant to produce soy fortified bread (see Section 2.2). The grant did not include technical assistance and A.I.D. requested FTB to provide technical assistance and support for the transfer of soy fortification technology and also for marketing studies to evaluate the potential sales of the Sam Lip product.

The transfer of soy flour fortification technology to Korea involved experimental and pilot-scale baking tests followed by commercial production of soy fortified bread in Korea to ensure an adequate supply of for test market introduction. Technical assistance was provided by FTB personnel and expert baking consultants. As a result, Sam Lip acquired the capability to produce fortified bread of acceptable quality with production costs ranging from -10 to +5 percent under or over that of regular bread depending on ingredient costs.

In preparation for the test market introduction of fortified bread, several activities were carried out. Initial consumer acceptance tests were carried out with company employees, and others to assess acceptability of fortified bread among Korean consumers. The tests showed positive results. Meanwhile a local firm was engaged to conduct a study of the bread consumption patterns in Seoul. Coincidently changes in the quality of flour used for bread production occurred and it was necessary to provide additional technical assistance to permit Sam Lip to make acceptable fortified bread. The outcome of these activities was a decision by Sam Lip to go ahead with the test market introduction. The test market plan was designed with technical assistance from FTB cooperators at Texas A&M.

The test market lasted two months. Fortified bread was offered at three prices -- equal to regular bread, 50% higher, and 100% higher to equal tne price of a

special milk bread which was in the Seoul market at that time. When priced the same as regular bread, fortified bread sold as well or better than regular bread during the test market. Sales at the higher prices were much lower than for regular bread.

Sam Lip decided to proceed with the market wide distribution in November 1976. Fortified bread was priced at a level higher than regular bread but lower than milk bread. Price control programs in effect at the time prohibited Sam Lip from obtaining a reasonable profit margin on regular bread and because soy fortified bread was not price-controlled, Sam Lip decided it must obtain a better return from the soy fortified product.

Sales of fortified bread in the first three months were good. After three months, promotion and advertising efforts were discontinued and after that, sales dropped significantly. Sam Lip stopped production in June 1977 when it decided that its limited resources would be better used promoting milk bread and other speciality items.

Despite the discontinuation of sales of soy fortified bread by Sam Lip, several accomplishments of significance resulted from this activity. The soy fortification technology was successfully transferred and applied to the commercial manufacture of soy fortified bread at a production cost essentially the same as that for regular unfortified bread. The soy fortified bread was judged to be of acceptable quality and, when priced equal to regular bread, achieved a level of sales sufficient to warrant continued production and marketing. This suggests that soy fortified bread can successfully compete when it is priced the same as other bread products and is supported by a promotion program. A summary of the Sam Lip activities was prepared jointly by FTB and Texas A&M (6.1).

El Salvador

In El Salvador the bread demonstration project was implemented jointly by a milling company, MOLSA, a bakery cooperative, COMAPAN, and a cooperative participating bakery PAN PALMERA. The project covered the period 1975-1978.

Soy fortification technology was transferred to El Salvador by FTB personnel. Soy fortified bread products were prepared in the mill bakery and a workshop was put-on for members of COMAPAN who might be participants in a countrywide program. The quality of the fortified baked products was judged to be equal or better than unfortified products and production cost was equal or in some cases lower than for unfortified products based on duty free importation of fortification ingredients (6.2).

Next, FTB provided the services of a market economist who assisted a local market research company in planning and conducting two studies. One study was a bread consumption and buying survey (6.3) and the other was a test market of soy fortified bread (6.4). The consumption survey showed bread products to be consumed by 95 percent of people on a regular, daily basis.

The test market was carried out with fortified bread produced by PAN PALMERA bakery. It included selling fortified bread for four weeks in 24 retail stores alongside unfortified product at the same price. Sales were good and consumer acceptance strong. The fortified product was preferred by the consumers and considered to be better quality.

The positive results of the test market were expected to prompt the full-scale production and marketing of fortified bread products in El Salvador. However, the GOES did not grant duty free status to soy flour and the expected program was not implemented. So again, despite the fact that FTB made technology

available with which protein fortified bread could be produced at low-cost, or even no additional cost over regular bread cost, the technology was not used. As in Korea, political and business reasoning prevailed and the expected welfare of consumers was secondary (6.5).

2.6.3 IMPROVING THE NUTRITIVE VALUE OF WHEAT FOODS

PURPOSE

In 1976, the A.I.D. Office of Nutrition, established a project for "Improving the Nutritive Value of Wheat Foods". The project was intended to be a vehicle to accelerate utilization of protein fortification technology which had been developed through A.I.D funded research. Its objective was to introduce soy fortified bread products in appropriate countries utilizing composite flour techniques. The five year project was implemented by USDA's Western Regional Research Center in Albany, California through a PASA. Monitoring responsibilities were assigned to FTB as part of RSSA activities.

PROCEDURES AND ACCOMPLISHMENTS

The initial task in the project was to identify 1-3 countries where the technology could be utilized. Wheat consuming countries were evaluated using selection criteria which included wheat flour consumption levels, protein deficiency in the target population, availability of local protein sources and interest by the USAID and host government. Seven countries were chosen as candidates. They were Bolivia, Costa Rica, Chile, Egypt, Morocco, Paraguay and Sri Lanka. Visits were made to these countries by a team of WRRC personnel and project proposals were made for Morocco, Costa Rica, Sri Lanka and Bolivia. These were followed by preparation of detailed assessment reports after country visits by a team of technical experts.

Bolivia emerged as the only viable candidate for a project and technical assistance was provided to Bolivia which resulted in the development of a program for protein fortification. The other candidate countries were not selected because protein fortification wasn't needed or it wasn't feasible to introduce technology or other approaches were being used to combat protein-calorie malnutrition.

Technical assistance was provided to Bolivia by WRRC over a five-year period. It included short-term technical assistance by cereal technologists, nutritionists, economists, process engineers, etc. who worked with in-country counterparts to develop a two-phase implementation plan for a composite flour program utilizing soy fortification technology. The project resulted in establishing an extensive infrastructure and cadre of skilled persons in Bolivia for composite flour testing. Provisions were made to develop engineering plans and cost estimates for refitting flour mills and a soy processing plant. Local studies were made of consumer acceptance and potential adverse physiological effects (flatulence) of fortified products. Baking evaluations of fortified bread and pasta were carried out and an economic feasibility study of a national program for flour fortification was completed.

The resulting implementation plan for introducing fortified wheat products to Bolivia was presented to the GOB who accepted it with modifications to include pasta fortification (6.6)

In 1981, the Ministry of Commerce and Tourism approved the plan and it was presented to an Inter-Ministerial Committee on Wheat for review. The GOB decree was issued requiring that wheat flour must be fortified with soy.

Unfortunately, the program for Improving the Nutritional Quality of Wheat Foods in Bolivia was not implemented. Due to a collapse of the Bolivian economy, the project was dropped and it has not been picked up again.

The nutritional objective of this project was to increase the general consumption of protein, and project activities led to a plan of action which would permit bread and pasta fortification in Bolivia with locally produced soy protein. If at some time in the future, nutritionists again conclude that the diets of the general public would benefit from more protein, the Bolivian project should be reconsidered and, if appropriate, implemented as a direct nutrition intervention.

2.6.4 RECOMMENDATIONS

Wheat and wheat flour are major food staples in many parts of the world and frequently provide half or more of the protein and food energy consumed by low income families. Clearly wheat can serve as a vehicle to provide supplementary nutrients to those families if needs are identified and local agencies decide to use fortification as an intervention. FTB activities demonstrated that wheat fortification technologies exist and can be used if local commitments are made. It is strongly recommended that A.I.D. give serious consideration to use of fortified wheat and wheat flour as nutrition interventions in the future.

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2.7 LOW-COST EXTRUSION COOKING (LEC)

2.7.1 INTRODUCTION

In 1974, the A.I.D. Office of Nutrition requested FTB to develop low-cost extrusion cooking (LEC) as a means of manufacturing inexpensive, nutritious foods and to transfer LEC technology to developing countries.

The request was based on exploratory work by FTB during 1972-73 which indicated that certain machines developed in the U.S. for processing soybeans to make animal feed also had potential for manufacturing precooked foods similar to corn-soy-milk (CSM) and other nutritional food supplements distributed overseas through the Food for Peace programs (7.1).

LEC extruders consist of a screw which forces dry, granular materials (like whole or ground soybeans and corn) through a tubular shell and out a narrow constriction or die at the end of the screw; while transitting the screw, the material is cooked with heat generated by friction from the energy furnished by the motor driving the screw. Initially FTB limited "LEC" to include only those extrusion cookers developed in the U.S to cook soybeans on the farm for use as ingredients in animal feed. Subsequently, the definition was expanded to include all small capacity, relatively inexpensive extrusion cookers.

The 1972 FTB studies had shown that LEC machines, driven by an electric motor or diesel engine, could cook up to 500-1000 pounds per hour of soybeans or soy-cereal combinations and that LECs require little training and few pieces of ancillary equipment to be made operational. The extruded LEC products, when ground to flour and fortified with vitamins and minerals, appeared to be

suitable as an alternative to CSM and to have potential to be manufactured in small factories in developing countries. The studies also suggested the machines could produce a variety of other products. These included full-fat soybean flour as a protein fortificant for bread and other processed foods, snacks and breakfast cereal type foods, pre-cooked cereal flours, textured plant proteins as meat substitutes and extenders, stabilized rice bran, and a number of industrial non-food products. However the major application for LEC foreseen by A.I.D. and FTB was the small-scale manufacture of CSM-type products within developing countries to replace imported Food for Peace commodities.

The following sections describe the major activities undertaken by FTB during 1974-1989 as FTB and its cooperators and contractors carried out the program to develop LEC technology and to transfer the technology to appropriate sites in developing countries.

2.7.2 LEC CAPABILITIES AND LIMITATIONS

PURPOSE

Low-cost extrusion cookers were identified as having potential for small scale food manufacturing operations as a spin-off of technical assistance provided to CARE/India. In the late 1960s and early 70s CARE was interested in establishing small factories to make foods for use in public feeding programs which it administered. CARE had established several pilot operations around India to test different processes and approaches. However, it had not found an inexpensive, small-scale means for cooking soybeans and cereals to obtain precooked blended foods such as those provided through Food for Peace.

At the suggestion of FTB, CARE procured an LEC (Brady Crop-Cooker, Model 206) which it installed in United Flour Mills, Calcutta in 1972. With assistance

from FTB, CARE evaluated tne LEC by producing test lots of a variety of pre-cooked food products based on wheat, rice, soybeans, peanuts, etc. CARE also cursorily tested the possibility of stabilizing rice bran using the Brady extruder. The results of the tests suggested that the Brady extruder could cook a variety of materials and create products similar to those provided to India through the U.S. Food for Peace program. However the tests also indicated that the LEC was unstable under some conditions and could easily become plugged by some of the raw materials. They also showed that the raw materials and processing variables could have a large effect on the product characteristics. The Calcutta tests made it clear that more needed to be known about the capabilities and limitations of LECs before they could be recommended for use in practical feeding programs.

Accordingly, in 1974, after considering USDA/ARS and other potential collaborators, FTB entered into a contract with Colorado State University (CSU) to install an LEC pilot plant and to undertake studies to determine the capabilities and limitations of LEC machines as related to production of low-cost nutrifoods in developing countries. The CSU studies were led by Judson Harper and Richard Jansen.

PROCEDURES AND ACCOMPLISHMENTS

Colorado State University (CSU) installed two LEC machines in its pilot plant, a Brady Crop-Cooker Model 206 and a Triple F InstaPro Model 500. Both machines were standard commercial units costing less than $10,000. No alterations were made to either machine. CSU scientists and engineers evaluated the performance of the machines using rice, corn, wheat, sorghum, soybeans, peanuts, and a number of other grains. Practical operating conditions were established for a range of throughput rates, temperatures, moisture additions,

etc. and the resulting products were tested to assess the organoleptic properties, storage stability, enzyme inactivation, nutritional qualities, and other properties (7.2). The results showed that:

- LECs are capable of cooking cereal/legume mixtures to produce dry irregular pieces suitable for grinding to make flours and meals which can be used in place of precooked blended foods supplied by the U.S. through the Food for Peace Program. The machines are also capable of cooking soybeans and inactivating the anti-growth factors to make a nutritious, full-fat soybean product suitable for use as a protein and energy rich food fortificant. No equipment modifications are required to produce these products.

- In order to obtain a uniformly cooked, grit-free product, it is desirable to pregrind the grain to make a flour or meal. Also, to assure smooth, trouble-free operations, the grain fed to the extruder should contain at least 5% oil. In addition, adding a small amount of water (about 5%) to the feed stock improves operations. (This small amount of water vaporizes during processing and no drying of the product is required.) However LEC systems require grinding, cooling, and other ancillary equipment in order to be operational.

- LECs are not capable of cooking pure cereal grains, such as corn, and are incapable of making uniformly shaped pieces similar to those found in commercial breakfast cereals and snack items. Textured vegetable protein products as used for meat substitutes and extenders cannot be produced with the LEC machines evaluated by CSU.

- Carl Cater of Texas A&M found that LECs are capable of inactivating the lipases in rice bran and stabilizing it so that it can be stored indefinitely and edible oil recovered from it (7.3).

Subsequent to these findings, other small, relatively inexpensive extrusion cookers were identified including the Meals for Millions extruder developed by Mark Sterner and the 4 1/2" Anderson Expander manufactured by Anderson International, Cleveland, Ohio. These machines cost somewhat more than the Brady and Triple F machines but nad more versatility and were capable of producing shaped pieces, cooking pure cereal grains without oil, and making textured proteins (7.2).

Concurrent with the research at Colorado State University, FTB arranged to make three Brady extruders available for demonstrations at technical institutes in developing countries. The objective of the demonstrations was to identify situations where LEC might have applicability and to stimulate interest among potential users. The initial demonstrations were undertaken at the East African Industrial Research Organization (EAIRO), Nairobi, Kenya, the Institution for Nutrition in Central America and Panama (INCAP), and Bogor Agricultural University, Bogor, Indonesia. Subsequently certain of the machines were moved to other sites in the Philippines, Thailand, and Pakistan for further demonstrations. CSU technicians assisted with the demonstrations by training local operators and explaining the functions and operation of the equipment.

As a direct result of the demonstrations, organizations in several countries became interested in LEC and decided to procure and use LEC for manufacture of food supplements. These countries included Tanzania, Costa Rica, Guyana, Thailand, and the Philippines. Other countries carried out in-depth studies of LEC but did not install manufacturing systems. A summary of the activities to evaluate the capabilities and limitations of LEC and to explore interest in utilization of the technology is available in the Proceedings of the First International Workshop on Low-Cost Extrusion Cookers held at CSU in June 1976 (7.2).

2.7.3 LEC FIELD TRIALS

PURPOSE

While FTB's activities provided useful information as to the capabilities and limitations of LEC technology and insights into places where the technology might be applied, a number of important questions related to practicality of the technology remained. In particular, there were questions as to

the durability of LEC machines during continuous use in developing countries, the requirements for training for operators and supervisors, the production capacity of LEC systems, the capital and operating costs of production units, and, of great importance, the utility of the product as low-cost nutritious foods. FTB and A.I.D. agreed that these questions should be answered through field trials in which LEC factories would be built and operated in LDC settings and where cost and operational data would be collected. Accordingly beginning in 1975, FTB set out to evaluate LEC technology through a series of field trials in developing countries.

PROCEDURES AND ACCOMPLISHMENTS

Three sites were selected for LEC field trials. The first was in Sri Lanka where FTB collaborated with CARE to establish an LEC factory to produce Thriposha, a blended food distributed by CARE in public feeding programs as a nutritional supplement for young children and pregnant and lactating women. The second was in Tanzania where National Milling Corporation, a public sector food manufacturing and distribution company, intended to manufacture a CSM-type product for distribution by the Ministry of Health in MCH programs and also to attempt its sale as a branded, retail product. And the third was in Costa Rica where CARE was promoting the production and consumption of soybeans and decided to establish a factory to make a variety of soy-based food products for use in public food distribution programs.

At all three sites, FTB entered into agreements to provide technical assistance to help the local organizations establish LEC factories that would enable them to reach their objectives and at the same time would permit FTB and A.I.D. to use the factories to collect operational and cost information with which to assess LEC technology.

Sri Lanka

The Sri Lanka field trial took place in two steps. The first was an LEC system installed at a rice mill near Kandy where a Brady extruder was used to cook a mixture of sorghum and soy as an extender for imported Wheat-Soy-Blend (WSB) to make Thriposha. FTB's cooperators at Colorado State University designed the system, supplied the equipment, and arranged for its installation in early 1976. The second step was to transfer the Kandy system in 1979 to Ja-Ela, a new site near Colombo where the factory was expanded with additional equipment supplied jointly by CARE and FTB. The new factory was designed by FTB's CSU cooperators and operated by Ceylon Tobacco Co. under contract to CARE (7.4).

The Ja-Ela factory was the first complete LEC factory and, at the time of this report, it has been in operation nearly round the clock for ten years. The product is a mixture of corn and soy, extrusion cooked in the factory with Brady extruders, and blended with imported Food for Peace commodities, vitamins, and minerals. The proportion of locally processed food has increased over the years to 50% at this time and is scheduled to be 100% indigenous ingredients by 1991. The output of the factory has regularly been 10-12,000 tons per year and it has been used as a supplement for up to 650,000 young children and mothers per year through the CARE administered maternal child health program.

As a part of the Thriposha program, some of the factory output was put up in commercial packages and sold by Lever Bros. of Ceylon as a retail product. Because the concept of selling donation-type food supplements appeared to have general applicability as a means of expanding nutrition intervention coverage, FTB provided technical assistance to CARE for test marketing and introduction of commercial Thriposha. Assistance was provided through FTB's Texas A&M cooperators. Although the sale of Thriposha appeared to be successful, CARE was

required to discontinue sales in 1985 when the capacity of the plant was insufficient to supply both public feeding programs and commercial distribution. Regretably, USAID/Colombo was unwilling to allow FTB representatives to travel to Sri Lanka to document commercial distribution of Thriposha at that time and no detailed reports are available on the subject.

The Thriposha food distribution program has been evaluated in terms of process and impact and found to be effective and to significantly reduce malnutrition among children (7.5).

Costs and performance of the LEC factory at Ja-Ela were evaluated by CSU over the period 1980 through 1982. The evaluation showed that the equipment was durable and reliable and could be run on a schedule comparable to other industrial extrusion factories operated in the U.S. The plant operated about 80% of the time it had been scheduled to operate, and only 25-65% of the down-time was attributable to equipment problems. (A large part of the down-time was attributable to power failures and plant logistics problems.) In addition, the capital and operating costs for the Ja-Ela factory were in fact quite low and justified the name "low-cost". During the period of evaluation, 80-90% of the costs associated with the factory were raw materials and packaging materials costs; expenses for labor, power, equipment and related processing costs were generally in the range 6-9% of the total costs of the product. A complete analysis of the Ja-Ela factory operations was prepared by CSU and distributed to those interested in utilizing LEC technology (7.4).

At the time of preparation of this report, the Government of Sri Lanka had committed itself to expansion of the factory and phase-over to use of 100% of indigenous raw material. A GOSL request for proposals to triple the capacity of the factory had been issued and selection of a contractor was in progress.

The Sri Lanka field trial was fully successful in demonstrating the practical utility of using LEC to manufacture nutritious food supplements in developing countries and gathering cost and operational data with which to assess LEC technology. In addition CARE's distribution of Thriposha in public feeding programs and its activities with Lever Bros. of Ceylon to introduce Thriposha as a commercial, retail product to reach other segments of the population were also very successful. FTB and CSU documentation of the Thriposha program has been used to stimulate other countries to consider use of LEC as a means of producing low-cost nutritious foods (7.6).

Tanzania

In 1977, after observing LEC demonstrations at EAIRO in Nairobi, the Government of Tanzania decided it wished to establish an LEC manufacturing system to make blended foods from corn and soybean for use in public feeding programs in place of imported Title II commodities. It also decided to explore sales of the product through retail outlets as a commercial venture.

USAID/Dar es Salaam requested FTB to use Tanzania as a site for an LEC field trial and to give assistance to National Milling Corporation (NMC) to design and build an appropriate LEC factory in Dar es Salaam. At the request of the Office of Nutrition, FTB provided the design for a factory and imported equipment and gave assistance to train Tanzanian technicians, all through FTB's cooperative agreement with CSU. The NMC factory was designed to produce a fully-cooked CSM-type product and was put into operation in 1978. The product was called Lisha.

In 1979, FTB and A.I.D. sponsored a Second International Workshop of Low-Cost Extrusion Cookers and held the workshop in Dar es Salaam (7.7). The newly

opened Lisha factory was an important element in the workshop and participants from nearly 20 countries viewed the operations of the factory and were impressed with the simplicity of the plant and the ease of operations.

Regretably, Lisha operations went downhill in 1979 when government funds were diverted from Lisna procurement to the war with Uganda. Also NMC inefficiencies delayed procurement of vitamins and minerals and essential replacement parts for the equipment, and distribution of the product became entangled in interagency rivalries. While the Lisha factory continued to operate intermittently, it was badly neglected and FTB was not able to collect useful information regarding costs and operations.

In 1986, Gregg Easterbrook, a writer for Science Magazine, visited Tanzania and wrote an article on the Lisha factory entitled "A Feeding Machine" (7.8). His article which commended LEC technology for its simplicity and low cost, was highly critical of A.I.D. and the project for "glossing over the practical social difficulties (of technology transfer) ... as if the cooker existed in a vacuum". Unfortunately Easterbrook missed the point of the field trial and failed to note the serious effort made by many experienced international specialists to account for the social settings in which technology transfer occurs. Regrettably he distorted or ignored the few facts he had collected and misrepresented the field trial to the general public through a popular magazine. The lesson to be learned from the Easterbrook article is not that development specialists should consider the social setting in their activities (which they know all too well), but that biased evaluations of development programs by inadequately informed journalists can easily threaten their efforts.

Another lesson is that long-term projects, even well considered projects, can fail when wars and other unplanned but not uncommon disruptions intervene. However it is clear that if development specialists refused to implement projects until all eventualities had been considered and the project found to be risk free, nothing would be done.

Costa Rica

The field trial in Costa Rica arose when CARE decided that soybeans, because of their high protein and low cost, might have a place in the diets of Costa Ricans. The CARE Country Director initiated a project to promote local production of soybeans and concurrently sought ways to utilize soybeans in local foods. During his inquires, the Country Director came across LEC technology and requested assistance from FTB to establish an LEC factory in Costa Rica.

In 1975, FTB and CSU cooperators aided CARE in the development of a project to install an LEC factory to manufacture a precooked corn-soy-blend to replace an identical product imported by CARE through the Food for Peace program and used widely in school feeding and other public food distribution programs. The project also called for manufacture of full-fat soybean flour which could be used as a protein fortificant for bread and as an ingredient in other foods. The Government of Costa Rica agreed to pay the costs of factory operations through a new social welfare program that had been instituted in 1974. The new program raised funds through a payroll tax and supported better nutrition and health among lower income groups by various activities including food distribution.

USAID/San Jose agreed to co-finance the construction of the factory with CARE, and A.I.D.'s Office of Nutrition agreed to provide the factory design and technical assistance for the factory as well as to help identify markets for new products through FTB and its cooperators. The CARE factory went into production in 1979.

The CARE LEC factory in Costa Rica operated for approximately 10 years and produced a variety of soybean-based food products (7.7). The corn-soy-blend product, which CARE called Nutrisoy, was found to have limited use in the family welfare program and production was discontinued. A market for full-fat soybean flour was not developed in Costa Rica and production was not initiated. However several products developed jointly by CARE and the food technology department of the University of Costa Rica (CITA) were manufactured in the plant and distributed to up to 450,000 preschool and school-aged children in Costa Rica. These included Vitaleche and Freschorchata (sweetened beverage-base products), Masarina (a soy fortified corn flour), and Frijolisto (precooked red bean flour). A total of 16-17,000 tons of product were manufactured and the plant was used on the average of one shift per day, five days per week during its 10 years of operations.

In 1985, responsibility of the plant was transferred from CARE to a special foundation set up to oversee the plant. The foundation was discontinued after about six months and responsibility for the factory reverted to CARE. At the same time, the Government of Costa Rica decided to shift the emphasis of their family welfare programs from health and nutrition to housing. Additionally, the government decided to not provide food directly to children but to give money with which to buy food. When CARE was unable to find commercial markets for products from the factory, the viability of the factory was undermined and in November 1988, CARE closed the factory.

Interestingly, in 1975, while CARE was developing its LEC project, a Costa Rican businessman, Delbert Clark, took an interest in LEC technology (7.7). Clark, working closely with CARE, procured a Brady extruder which he installed in his Pronutre, S.A. factory near San Jose, and began manufacture of several products. One product was instant pea soup which Clark made from peas supplied through

Food for Peace and which were processed and distributed under contract to the GOCR family welfare program for use in public feeding programs. Another was soy-fortified tortilla flour which Clark distributed through retail outlets as a commercial product. Clark also collaborated with Mexican technologists in the development of LEC products manufactured and used in Mexico (see Section 2.7.4 below). Clark's operations including LEC were discontinued in about 1983 when his company failed.

The Costa Rican field trial, like the Sri Lankan operation, demonstrated the feasibility of operating LEC systems in developing countries. However it also illustrated the hazard of dependance on a government-sponsored program for viability. When the Government of Costa Rica changed its priorities to exclude direct procurement of food from the factory, and CARE was unable to identify alternative markets for the product, the factory failed. While this didn't occur until after 10 years of operations, a rather long life-time for specialty food products, it could have occurred at any time when a newly elected government took office or a new government decision maker was appointed. Clearly it would be better for CARE to have developed multiple markets for the products from the LEC factory so that it would not have been totally dependent on the GOCR. At the same time, it should be clear that CARE and most other implementing agencies with which A.I.D. works are not oriented to commercial market development -- and even if they were, commercial markets can also fail or falter after a period of time as did Mr. Clark's business. As a practical matter, the Costa Rica experience suggests that, if reasonably possible, LEC factories should be designed to serve multiple markets in order to lessen the dangers of dependence on particular government programs or particular commercial market segments.

2.7.4 TECHNOLOGY PROLIFERATION

PURPOSE

The studies of LEC capabilities and limitations and the LEC field trials outlined in the previous sections demonstrated that LEC technology can be transferred to developing countries and used there to make inexpensive, nutritious food products. While the field trials didn't demonstrate the full range of product capabilities, they provided evidence that cereal-based blended foods like CSM and CSB can be manufactured and used in place of imported Food for Peace commodities as local food supplements, especially as weaning foods. They also suggested that certain other products like instant soups, beverage-bases, and precooked cereal flours (like tortilla flours) might be made with LEC technology and might find a place in the local food cultures. But the field trials pointed out the need to make food products which mesh with local eating habits and to confirm up-front that the foods will have a good reception among the feeding program recipients and other intended users.

In addition, the trials pointed to the need for assistance from experts for factory design and for training of the plant supervisors and equipment operators, and the desirability, at least in the early stages, to have a source of technical assistance for troubleshooting. And as found at every field trial site, strong local management is needed to cope with procurement of raw materials and spare parts for the factory, provide capable personnel, and balance quality and costs against production objectives. In short, the trials showed that LEC technology transfer is not unlike other technology transfers that are made not only overseas but in the U.S.

LEC technology differs in one respect from most other technologies in that it is likely to be implemented by governments and/or private voluntary groups who have

little or no experience with the manufacturing arts. Accordingly, LEC technology transfer and utilization is heavily burdened with decisions rendered by individuals with little or no relevant experience.

Based on these findings, A.I.D. and FTB entered the final phase of the activity, proliferation of LEC technology. The purpose of this phase was to promote utilization of LEC technology and to transfer the technology to developing countries where it could appropriately be used.

PROCEDURES AND ACCOMPLISHMENTS

FTB and A.I.D. had initiated technology transfer activities during the early stages of the project by providing demonstration equipment and conducting workshops to acquaint potential users with LEC technology as outlined above. As a result, a number of counties explored LEC and several decided to build and operate LEC factories.

Subsequently FTB cooperators published an LEC Newsletter to further stimulate interest in the subject. The Newsletter was circulated twice yearly during the period 1976 to 1989 to over 700 persons and institutions that had shown interest in the technology. A detailed report on the Thriposha field trial was published to illustrate uses for LEC technology and it was also circulated widely (7.6). An additional report on another LEC facility in Mexico was also published and circulated (7.9). FTB cooperators at Colorado State University published a brochure entitled "Low-Cost Food Factories" offering CSU's service for technical assistance to design factories and train plant personnel (7.10). The services of FTB cooperators at Texas A&M who were involved in the commercial marketing aspects of LEC products in Sri Lanka, Tanzania, and Guyana were also announced. The role of marketing in developing and introducing LEC products was outlined in

a Texas A&M publication covering LEC activities in Guyana (7.11). CSU independently developed a short-course on extrusion cooking which it held on several occasions at Ft. Collins, CO during 1987-89.

Collectively these various activities led to factories being built in a number of countries, some with A.I.D. and FTB assistance and some without. The following paragraphs briefly describe the additional factories which were build directly or indirectly as a result of the LEC project and associated activities.

Guyana

Guyana Pharmaceutical Corporation (GPC), a public sector company in Georgetown, Guyana, learned about LEC technology during demonstrations of the technology at INCAP. Subsequently GPC representatives saw the CARE LEC factory in Costa Rica and decided to manufacture a cereal-based, pre-cooked weaning food for commercial distribution in Guyana. They proceeded with procurement of a Brady Cooker and simultaneously sought technical assistance through USAID/Georgetown. The USAID Mission requested help from the A.I.D. Office of Nutrition and the assistance was provided by FTB in collaboration with its CSU and Texas A&M cooperators. FTB helped GPC prepare a proposal to USAID for a project to build an LEC factory to manufacture a weaning food that could be sold commercially to reach Guyanese infants and children ages 6 months to two years. A secondary market segment designated by GPC was toddlers age 2-5 years. The product was to be made from local ingredients and priced to reach all but the lowest income groups. The lowest income families were to be reached through an existing maternal child health program through which a part of the product was to be distributed free of charge. The factory was to be housed in a GPC building jointly with another LEC system financed by GPC and used to make commercial, products including breakfast cereals, precooked corn flour, instant soups, and other products to be identified later.

USAID/Georgetown agreed to co-fund the project along with GPC and pay up to $500,000 for imported equipment and packaging materials and for local costs for introduction of the product and evaluation. USAID also agreed to supply imported cornmeal, soybean flour and oil, milk powder and vitamins and minerals to complement locally supplied rice and sugar until corn and soybean production in Guyana came up to speed. A.I.D.'s Office of Nutrition provided technical assistance to develop the product, design of the factory, and market research. The project was initiated in 1978 and the factory was completed in 1980.

The weaning food produced in the GPC LEC factory, which was called CEREX, was introduced in the retail market in 1980 and was quickly distributed throughout Guyana. In 1981, GPC, with assistance from FTB cooperators from Texas A&M, undertook a national consumer survey to determine usage of CEREX (7.11). The survey concluded that:

- Nearly three quarters of the households had tried CEREX and 62% were still using it at the time of the survey.
- 86% of the households using CEREX were satisfied with it.
- Among the primary target group (children under 2), 79% had used CEREX, 58% were still using it, and 27% were using it in the recommended amount (1/4 cup or more, 2-3 times per day).
- Among the secondary target group (children 2-5), 62% had tried CEREX, 41% were still using it, and 17% were consuming it in the recommended amount.

These extremely favorable results were due in part to the shortage of imported, packaged foods in Guyanese retail stores due to an economic crisis at the time. Nonetheless, the Guyana project provided further proof that LEC products can be culturally acceptable and that inexpensive weaning foods can be delivered to the public through commercial marketing channels.

Mexico

In 1977, CIATECH, a small state financed development institution in Chihuahua, Mexico set out to find ways in which locally grown soybeans could be used in the diets of low-income Mexican families. American Soybean Association representatives referred CIATECH to LEC technology as a possible means of converting soybeans to food and CIATECH representatives visited FTB cooperators at Colorado State University to obtain details. The resulting CIATECH program was spectacular in its accomplishments. During the period 1977-1983 CIATECH, with no financial assistance from A.I.D., achieved the following results:

- Built and operated an LEC factory near the town of Delicias which was capable of producing (1) full-fat soybean flour for use as an ingredient for processed foods, and (2) a cereal-based, precooked infant food. Soyflour produced at the Delicias factory was sold to a number of Mexican food companies and used as a replacement for dried eggs and for other purposes. However the major use was as a protein fortificant for tortilla flour and in 1983 5000 tons of soy enriched tortilla flour reached and estimated 800,000 people. The Delicias factory also produced Soyaven, a soy-oat product which was marketed through supermarkets and drugstores as an infant food for children with allergies to milk.

- Built and operated a liquid-milk processing plant in Albachisa to reconstitute milk powder and extend it with soybean milk made from soybean flour from the Delicias factory. Low-cost milk products made in the Albachisa factory were sold commercially in and around Chihuahua and in 1982 production reached 6000 liters a day, enough to reach 25,000 people.

- Built and operated an LEC factory in Cuauhtemoc to produce corn- and soy-based food supplements for use in Mexican public feeding programs and precooked, soy-fortified corn flour for sale in supermarkets. The Cuauhtemoc factory used all indigenously manufactured equipment including LEC extruders patterned after American machines but designed and built by CIATECH engineers.

The Chihuahua program demonstrated not only that LEC technology could be used effectively to produce new, inexpensive nutritious food products, but that the technology can be transferred and used with minimal inputs from the U.S. The Mexican project established that the LEC technology is simple enough that the

machines can be easily operated and maintained in a developing country setting, and in fact so simple that the extruder and all ancillary equipment can be built locally (7.9).

Ecuador

In 1981, the World Food Programme indicated that it was phasing out the donation of rolled oats to the Ecuadorian Government (GOE). The rolled oats were used by the GOE along with defatted soy flour and non-fat dry milk to make "Leche Avena", a nutritious, uncooked, supplemental food for use in its MCH programs. The Food Technology Unit of the Andean PACT Organization, familiar with FTB's LEC work, initiated a project with the GOE to design and build an LEC food factory nearby Quito to replace the pending loss of Leche Avena and to increase production. The new plant was intended to use indigenous commodities.

FTB through its cooperators at CSU provided technical assistance to the GOE and USAID to assess the resources, advise on design of the plant, provide training in LEC operations, and assist start-up operations which commenced in late 1982. The new product was called Leche Arroz and was composed of co-extruded broken rice and soybean blended with nonfat dry milk and vitamins and minerals. Alternatively, broken rice could be ground and blended with soy flour, non-fat dry milk, vitamins and minerals to produce an uncooked product. The plant, installed in the same complex as the Leche Avena operation, has operated intermittently on various formulations since that time depending on the availability of funds and local commodities and the need for product beyond that available through donations. There is a current plan under consideration to renovate and possibly relocate the plant to manufacture different types of products to meet other needs of the Ecuadorian populace.

Zaire

In 1985 USAID/Kinshasa made a grant to the Organization for Rehabilitation through Training (ORT) to support a number of nutrition interventions in Zaire. Among the activities was a project to assist Victoria Assorted Products (VAP), a Zairian private sector company, to build a factory to manufacture a weaning food for commercial retail distribution (7.12). The assistance provided by A.I.D. was unusual in that it included a monetization component in which ORT was supplied with Food for Peace milk powder that ORT sold in the open market and then used the sales proceeds to support the VAP activity.

VAP had developed a weaning food product in 1983 and had sold limited amounts of the product through retail outlets in Kinshasa. The product was a precooked wheat and corn product fortified with soybeans and milk powder and sweetened with sugar. It was made by baking the ingredients in the form of biscuits (cookies) and then grinding the biscuits to make flour. This cumbersome process was unnecessarily expensive and VAP wished to use LEC to precook the ingredients, reduce the costs, and permit VAP to expand its market by selling a lower priced product. VAP also wanted to be able to use the manufacturing system to make products other than weaning food (such as snacks) to achieve economies of scale and to proliferate its product line.

FTB and its cooperators at Colorado State University and Texas A&M provided technical assistance to VAP to help select equipment, design the new processing system, and advise on marketing. In 1987 VAP installed a new LEC system with two Anderson 4 1/2 in. extruders and began production of its new, extrusion cooked CEREVAP weaning food. According to reports from ORT, in 1989 CEREVAP is the most widely consumed commercial weaning food in Zaire.

The ORT project in Zaire provides a blue print for other projects in wnich Title II commodities might be used indirectly through monetization to support local, private sector food processing operations.

Other

In addition to the LEC facilities described above, a number of other projects were assisted by FTB and its cooperators. Some of the assistance resulted in use of LEC technology in factory settings including a system in Santa Cruz, Bolivia operated by Nutrinal S.A. to make corn-soy products (7.7) and a weaning food factory in Chaing Rai, Thailand built for the Government of Thailand by Kaisetsat University in Bangkok (7.7). Other countries examined LEC tecnnology in depth carrying out product development and consumer studies or feasibility studies but ultimately did not implemente production operations. These included Honduras, the Philippines, Indonesia (7.7), and Sudan (7.13, 7.14, and 7.15). In 1988-89, FTB assisted the Government of Botswana to examine possibilities to replace imported Food for Peace commodities with local foods made with LEC (7.16 and 7.17)

2.7.5 EMERGENCY FEEDING

PURPOSE

The 1983 drought in Ethiopia resulted in mass famine and displacement of enormous numbers of people. Because of the urgency of the problem, only whole grains were made available from international donors for rapid response. Grain cargos already at sea were diverted to Ethiopia. However, displaced persons had lost most of their household goods and were unable, in many instances, to transform whole grains into edible products. Furthermore, wood supplies were quickly depleted and cooking fuel became a serious problem. Thus one of the critical

needs identified in the disaster was the need for local whole grain processing and cooking capability.

In 1985, FTB proposed that a portable low-cost extrusion cooker factory might be used to process whole grains to produce ready-to-eat foods and precooked flours and grits that could be used as gruels, weaning foods, and rehabilitation foods. FTB suggested that A.I.D. build and operate a portable LEC food factory at a displaced persons camp in Ethiopia, Sudan or other location to demonstrate the concept. Implementation was to be carried out by a PVO with technical assistance from FTB and its Cooperator, Colorado State University (CSU).

PROCEDURES AND ACCOMPLISHMENTS

A preliminary design for a portable LEC food factory was prepared by CSU. Its cost was estimated to be $200,000 for a capacity of 400 to 1,000 lb/hour of whole grains (e.g. a combination of corn and soybeans) enough food to supplement the diets of up to 50,000 persons. The cost did not include grain cleaning or packaging equipment or any building or tent for housing the mobile factory. The plant was designed to be mounted on skids that could be transported by air. A diesel powered electrical generator, proportioning mill, extruder, cooling conveyor, and hammermill were all included. Raw materials and product were to be handled by local labor which was expected to be available in the camp.

Potential funding of $100,000 was identified from A.I.D. Office of Foreign Disaster Assistance through a special grants program to PVO's to assist disaster relief. FTB and its cooperator, CSU, agreed to provide technical assistance. Additional funds were to be furnished by the PVO to complete the equipment purchase, organize the project, and operate the unit. PVO's were contacted for interest. CRS/NY indicated an initial interest. Contacts with USAID and CRS in

Ethiopia and Sudan were made but because of anticipated operational difficulties and heavy work load of its on-site personnel during the emergency, CRS declined to participate and the project was tabled.

A lesson learned through this activity was that it is difficult to carry out development activities during a disaster -- the urgency of coping with serious problems when resources are limited tends to rule out developing and testing new concepts of this type. It is recommended that A.I.D. consider developing and testing a mobile food factory during a period of non-crisis and, if the factory appears to be manageable, consider putting one or more factories in storage and making them available on demand for use during emergency situations.

2.7.6 RICE BRAN STABILIZATION

PURPOSE

Rice Bran is a product of rice milling. It contains significant amounts of protein and 15 to 20 percent oil but is used largely for animal feed. The oil is suitable for use as a food and, when extracted from the bran and refined, has been marketed successfully in competition with corn, peanut, soybean and other high quality, food grade, vegetable oils.

Unfortunately, rice bran contains very active enzymes which go to work immediately after milling to hydrolyze (break down) the oil to form free fatty acids and glycerine. Unless the oil is removed from the bran within 1 or 2 days, too little oil is left to justify recovery. While the hydrolyzed oil products have value for soap making and other industrial use, they are not suitable for higher value food uses. As a result, only limited quantities of food-grade rice oil are produced.

Of the roughly 500 million tons of rice produced annually in the world, about 150 million tons are processed in modern two-stage rice mills which produce rice bran as a separate by-product. Other rice mills produce a mixture of bran and hulls which is not suitable for rice oil recovery. If hydrolysis of the oil in bran from two-stage mills could be prevented and if the oil were recovered, about 1.5 million tons per year of edible oil could be added to the world's food supply.

Nearly 28 years ago, Anderson International Corporation, Cleveland, Ohio, discovered that the enzymes in rice bran which cause hydrolysis of the oil can be destroyed by treatment in extrusion-cookers. Although Anderson patented its discovery, the process was not used commercially, in part because extrusion-cookers available at the time were large, expensive, and required costly accessories such as steam generators, and driers.

In 1972 when USDA/OICD and A.I.D. began to explore the use of low-cost extrusion cookers (LEC) to produce food supplements in developing countries, the possible use of these machines for rice bran stabilization was noted. Although USDA and A.I.D. did not actively pursue stabilization at that time due to the press of other activities, Carl Cater of Texas A&M carried out successful rice bran stabilization test with an LEC (7.3). Subsequently, in the mid 70's, tests by various institutions with whom USDA was collaborating in Indonesia, the Philippines, and Thailand confirmed Cater's findings. However it was still not clear that rice bran stabilization and recovery of edible oil could be operationally and financially feasible and thus A.I.D. requested FTB to undertake a project to determine this.

PROCEDURES AND ACCOMPLISHMENTS

In 1979, A.I.D. provided funds to FTB to explore the feasibility of rice bran stabilization and recovery of edible oil. As a first step, OICD entered into an agreement with USDA/ARS's Western Regional Research Center (WRRC) to study feasibility through analysis and testing. An initial analysis published in 1981 by WRRC indicated that production of edible oil from extrusion-stabilized rice bran could be financially sound (7.18). The WRRC analysis drew heavily on cost data from LDC's but also was based on many technical and financial assumptions. Subsequently, WRRC confirmed some of the assumption in its analysis through operation of an LEC system installed in a commercial rice mill in California (7.19). These tests established optimum conditions for stabilizer operation and enabled WRRC to obtain enough stabilized bran to conduct studies of the product including laboratory oil extraction studies and compositional studies (7.20). Chick feeding studies were successfully carried cut on the defatted, stabilized bran (7.12).

The WRRC work provided evidence that extrusion-stabilization of rice bran should be technically feasible. But, before USDA and A.I.D. could promote stabilization among LDC's as a practical technology, it was believed important to have direct evidence that all aspects of bran stabilization and oil recovery are feasible (i.e. the operational, logistical, marketing, and financial aspects should be workable and acceptable to prudent businessmen).

In April 1984, USDA and A.I.D. entered into an agreement with the National Food Authority of the Philippines (NFA) to undertake trials of extrusion-stabilization of rice bran in the Philippines. NFA agreed to test the stabilizer system as a part of its own rice oil project and USDA and A.I.D. agreed to furnish the stabilizer system along with technical assistance for its operation in exchange for operational and cost data from the project with which to

evaluate feasibility. USDA's cooperators from Colorado State University (CSU) took responsibility for design of the stabilizer system, technical assistance to NFA, and collection of data for the feasibility study. In early 1985, CSU and NFA completed installation of a 1000 pound per hour rice bran stabilizer system at the NFA rice processing complex in Cabantuan, Central Luzon. Cost of the system was $50,000. The pilot project was designed to be profitable, i.e., NFA was expected to be able to recover all operating costs from sale of oil and defatted bran plus a small profit.

Although approximately 300 tons of rice bran were "stabilized", no oil was extracted or refined and FTB was unable to complete the feasibility study. A series of problems were encountered with the NFA system including: excessive extruder wear, incomplete stabilization, inadequate rice bran supply, and interruptions due to weather. In addition, a new Filipino government in early 1986 replaced all top NFA officials and the new NFA officials decided to discontinue the project.

A review of the project accomplishments in early 1987 noted that significant strides were being made in commercializing rice bran stabilization in the U.S. and India (7.22). USDA concluded that much of the information being sought in the Philippines was being generated elsewhere. In 1989 FTB prepared a technical report based on these new sources of information together with information from the Philippines and elsewhere (7.23). The report suggested rice bran stabilization coupled with edible oil recovery is technically feasible but that financial feasibility is marginal in situations where the rice bran oil must compete in world oil markets with soybean, cottonseed, corn, palm and others. On the other hand, where food oil resources are scarce and there is a lack of foreign exchange or high priority to replace imported oil, government incentives can make rice bran oil production financially feasible.

India is an outstanding example of a situation where government incentives and protection are leading to extensive use of rice bran for oil production. India has imported 42 Brady extruders and several Anderson extruders from the U.S. for use with rice bran. At this time, there is insufficient information publicly available to know how successful extrusion stabilization is in India but the technology is being given an extensive commercial trial. In the U.S., rice bran is being commercially stabilized with extruders. The majority of the stabilized rice bran is being exported to the Pacific Rim countries for oil recovery and use of the defatted bran in animal feeds. Some stabilized rice bran is also being used in the U.S. as a food ingredient in multi-grain breads and crackers where it contributes a significant level of dietary fiber. Recent animal studies (human studies in progress) have shown rice bran has cholesterol lowering capacity similar to oat bran and this has greatly excited the U.S. rice industry and stimulated further interest in extrusion stabilization of rice bran.

2.7.7 RECOMMENDATIONS

The A.I.D. experience in developing Low-Cost Extrusion Cooking (LEC) as a new technology for developing countries to make inexpensive, nutritious foods was, for the most part, successful. It resulted in the installation of a number of food factories which made special food supplements which were distributed to hundreds of thousands of low-income families. In addition, it provided a valuable experience for both A.I.D. and A.I.D.'s counterparts in technology development and transfer that revealed some of the pitfalls which a donor agency can encounter in the fields of nutrition and food technology. However there is much yet that can be done to utilize LEC if A.I.D. decides to further exploit this useful new technology. Given an appropriate budget and a competent implementing organization with skilled personnel and a pilot plant facility, the following activities can be carried out:

-- Additional sites can be identified for LEC factories, and technical and financial assistance can be provided to develop appropriate products, design and build factories, train personnel, and provide back-up assistance during the early stages of production and distribution. Factories can be used not only to make special nutritional supplements but also a variety of commercial products such as snacks and breakfast cereals, precooked soybean and cereal flours, pet foods and animal feeds, foundry core binders and oil-well drilling mud additives, etc. These activities can lead simultaneously to strengthening the food and industrial sectors of LDCs and to improving human capital through direct nutrition interventions with nutritious food supplements.

-- The technology for stabilizing rice bran and recovering edible rice bran oil developed by FTB can be further exploited by disseminating information to countries where vegetable oil is in short supply and rice bran oil could effectively add to the local food supply. This could be accomplished by providing support to U.S. private sector organizations which have rice bran stabilization know-how but are unable to transfer the know-how overseas due to lack of resources.

-- Additional new LEC products and processes can be developed and transferred overseas. These might include textured protein products, such as meat substitutes and extenders, and soybean-based milk extenders. These types of products were created in the U.S. to reduce costs to the consumers but have not been fully exploited in developing countries where food costs are a major problem.

-- The use of LEC technology to process grain to make precooked, ready-to-eat foods using portable/mobile LEC systems should be investigated as a means of furnishing food to displaced persons and refugees during emergencies.

It is recommended that A.I.D. continue support for a program to utilize LEC by entering into a contract or agreement with an organization with existing know-how and pilot facilities and by providing long-term support for the organization to transfer technology to LDCs.

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2.8. HOME AND VILLAGE PREPARED WEANING FOODS

2.8.1 PURPOSE

One of the serious problems found in all developing countries is malnutrition resulting from inadequate food intake among infants and young children. This in combination with poor sanitation, high prevalence of diseases, insufficient health and medical services, and other factors associated with poverty result in appalling infant and childhood mortality rates throughout the developing world. The problem will undoubtedly diminish and eventually disappear with economic development as envisioned by the current U.S. development strategy. However, in the intervening decades, the international development community, including A.I.D., has mounted programs to help alleviate the problem and promote child survival at a more rapid pace.

Among the child-survival activities, there have been massive programs to support immunization against childhood diseases, to distribute oral rehydration salts (ORS) to help children recover from diarrhea, and, on the food side, to distribute millions of tons of food commodities to those most in need through the World Food Program and bilateral programs such as the U.S. Food for Peace program. Also among the programs have been a number of small but pointed efforts to try to change the dietary practices of low-income families so that infants and young children will have better food intake and hence better nutritional health and improved survival rates. One of these activities was the Home and Village prepared Weaning Food Project (HOVIPREP) carried out by FTB in cooperation with Harvard and MIT.

The HOVIPREP project began in 1979 when the A.I.D. Office of Nutrition requested FTB to undertake a program to promote consumption of home and village prepared

weaning foods as a means of improving the nutritional status of children of low-income families in developing countries. The new activity was intended as an add-on to FTB's work on centrally processed weaning foods distributed through public feeding programs and retail outlets (see Section 2.7). A.I.D. allocated roughly $200,000 per year for a period of three years for FTB's home and village prepared weaning food activity.

2.8.2. PROCEDURES AND ACCOMPLISHMENTS

In 1979, FTB contracted with Sandra Callier, a New Transcentury Foundation consultant, to develop a scope-of-work for the FTB project to promote home and village prepared weaning foods and to identify institutions and individuals who could provide expertise to assist FTB deliver technical assistance to A.I.D. supported projects in developing countries. Ms. Callier concluded that the FTB project should (1) disseminate information about and stimulate interest in projects to overcome malnutrition through the use of home and village prepared weaning foods, and (2) identify organizations in LDCs that wish to implement home and village prepared weaning food activities and provide technical advisory assistance for planning, developing, implementing and evaluating those activities. She identified Harvard and MIT as major centers of expertise with institutional access to other experts that could help FTB provide the required technical assistance.

Based on Ms. Callier's findings, FTB entered into a cooperative agreement with Harvard University (No. 58-319R-1-86) to support Harvard, MIT, and affiliated institutions to collect information, provide technical assistance and otherwise promote national programs in LDCs to improve the nutritional status of infants and young children through the use of home and village prepared weaning foods. The agreement started in October 1980 and terminated in December 1983 when

A.I.D. decided to enlarge and broaden its program through a new A.I.D. project devoted to weaning practices, research, and technical assistance, and which was implemented through a private sector contract.

The HOVIPREP project was led by Dr. Gretchen Berggren of Harvard (1980-82) and Dr. Nevin Scrimshaw of MIT (1982-83). Dr. Robert Morgan served as the Washington Project Coordinator and was located with FTB in USDA offices in Washington. The project was supported through a roster of 50 professionals including experts in food technology, behavioral sciences, medicine, and agriculture. It also utilized the special technical libraries and the faculties of Harvard and MIT as resources for project activities.

One of the outputs of the project was a WEANING FOOD ARCHIVE, a collection of about 500 published and unpublished articles on all aspects of weaning foods (8.1). A.I.D. and USAID Missions were informed about the Archive and copies of articles provided upon request. The Archive collection was left with Harvard on termination of the project.

In 1982, leading experts in weaning food activities from around the world convened at MIT to develop a manual to help guide policymakers, program planners, and fieldworkers on all aspects of weaning food programs. The manual entitled "Improving the Nutritional Status of Children During the Weaning Period" was published in 1984 and has been distributed widely through A.I.D., Harvard, MIT, UNICEF and USDA (8.2).

HOVIPREP staff also published case studies on home and village weaning food projects which had been implemented in developing countries including the Nutrition Demonstration Foyer Project in Haiti (8.3) and the Sarbottam Pitho Project in Nepal (8.4).

Technical assistance was provided through site visits in 14 countries through 17 consulting missions. These missions served to stimulate interest in weaning food activities. In several countries the HOVIPREP consultants helped develop specific proposals for local institutions to implement.

A final report outlining the the objectives, procedures, and accomplishments of the Harvard/MIT HOVIPREP Project is attached (8.5).

2.8.3 RECOMMENDATIONS

The HOVIPREP project served to stimulate interest in the nutritional needs of young children and the importance of mounting programs to promote greater use of weaning food supplements at the home and village level. However it also demonstrated that although a small project can stimulate interest and pull together a cadre of individuals with shared concerns, it can't support an effective program to solve major international development problems. Massive worldwide problems can't be dealt with through $200,000 a year budgets or even with budgets that are an order of magnitude larger as was the case of the A.I.D. follow-on project. Coping with the problem of improving the diets of the 500 million needy infants and young children in LDCs requires budgets at least as great as the $100-500 million per year allocated to child survival and Food for Peace. And that type of budgetary allocation obviously requires commitment at the highest level, a commitment that seems unlikely in the context of today's revenue deficits and austerity campaigns.

Unless or until commitment is made, it seems reasonable to undertake activities that will maintain interest in home and village prepared weaning foods and related child feeding issues. This can be done by continuing to "stir the pot" so that the technical resources will be on hand if needed. A.I.D. is carrying on this type of activity through its Weaning Practices and associated projects.

In the HOVIPREP final report (8.5), a number of suggestions were offered for follow-up. Among these was the proposal that activities to promote weaning foods or food supplement for infants and young children should be integrated with other child survival interventions (growth monitoring, ORT, breast feeding, immunizations, etc.) as a package to be promoted by A.I.D. and other donor agencies. The report also urges that efforts should be focused on identifying and field testing effective weaning food interventions, pointing out that the present state-of-the-art is weak and in need of well-considered, proven programatic approaches.

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2.9 SOYBEAN UTILIZATION

2.9.1. PURPOSE

Soybeans can provide an inexpensive source of good quality protein and nigh energy vegetable oil in countries where the climate and soil are favorable for soybean production. Historically, soybeans have been priced at only 1/4 to 1/2 as much as ordinary beans yet provide 15-20% more calories and over 50% more protein on a weight basis. Furthermore, soybeans have been used as a staple food in the diets of many people, particularly Asian people, and in recent years, processed soybeans have become well known in the diets of Americans and Europeans through commercial utilization of meat and milk extenders and substitutes. Accordingly, in the 1960s and 70s, many international development organizations including A.I.D. undertook projects to promote soybean production and consumption in developing countries.

A.I.D.'s Office of Agriculture provided funding to the University of Illinois International Soybean Program (INTSOY) to assist developing countries produce soybeans and find domestic uses for them. Concurrently, A.I.D.'s Office of Nutrition indirectly supported soybean utilization through FTB by helping to develop food supplements for children which contained significant amounts of soybeans. As noted in the section of this report dealing with Low-Cost Extrusion Cookers (LEC), FTB projects for the manufacture of soybean-containing foods were implemented in Sri Lanka, Thailand, Tanzania, Zaire, Costa Rica, Guyana, Bolivia, and Ecuador; many millions of families were supplied with soy-containing processed foods from these factories (see Section 2.7). In addition, FTB developed Whey-Soy Drink-Mix for distribution as a milk substitute in Food for Peace programs (see Section 2.5) and promoted use of soybean flour as a protein fortificant for bread (see Section 2.6).

In 1975, A.I.D. decided to focus more attention on soybean utilization by promoting direct consumption of soybeans at the home and village level. FTB was requested to explore ways in which soybeans could be used for food without central processing, and also to help A.I.D. develop a project to identify simple and effective ways to introduce soybeans as food by the rural poor.

2.9.2 PROCEDURES AND ACCOMPLISHMENTS

As an initial step, in 1976 FTB organized a study by USDA/ARS's Northern Regional Research Center (NRRC) to review the uses of unprocessed and simply processed soybeans as human food. NRRC scientists carried out a thorough review of the literature covering worldwide soybean consumption practices and prepared a report of their findings (9.1). The report detailed food uses of soybeans by country and summarized simple processes for utilizing whole soybeans. The report also included a section on barriers to accepting and using soybeans in food. The NRRC work was monitored by FTB and funded through an A.I.D. Office of Nutrition PASA (AG/TAB-225-12-76).

A further activity, sponsored jointly by A.I.D.'s Offices of Agriculture and Nutrition, was a project to develop a methodology for introducing unprocessed or simply processed soybeans as a direct food in developing countries and to use the methodology in one country. FTB assisted A.I.D. develop a Project Paper for this activity and worked with A.I.D. contracts to select an implementing organization. In 1975, the University of North Carolina, Chapel Hill, was selected by A.I.D. to undertake the project and FTB served as A.I.D.'s representative to monitor the UNC project.

The UNC soybean utilization project was implemented in Bolivia in the vicinity of Cochabamba. UNC workers studied the food habits of people in that area and, in collaboration with North Carolina State home economists, developed a set of

recipes for use of soybeans in local food preparations. Working with local businessmen, arrangements were made to assure that soybeans would be available in the retail markets. Then UNC launched a major campaign to introduce soybeans to Bolivian consumers using mass media, mother's clubs, extension workers, and a number of other promotional activities. All of UNC's work was carried out in close cooperation with local authorities and using support from Bolivian institutions.

After a substantial period of introductory activities, UNC measured the consumption of soybeans among families in the Cochabamba area. Even after UNC's major effort to promote use of soybeans, it was found that per capita consumption of soybeans was only about 3.0 grams per day. While some families used soybeans regularly, it was clear that the UNC program had not succeeded in making soybeans a food staple in the Cochabamba area of Bolivia.

It had been expected that Bolivians would replace the usual legumes in their diets with less expensive, more nutritious soybeans. People in other countries, particularly Asian countries, used soybeans as a food staple and it seemed reasonable that Bolivians could also. However the UNC project showed that Bolivians were not prepared to do so, at least after a period of about two years of exposure to an intense promotional campaign. The Bolivian soybean introduction failed.

There is clear evidence that consumers, including consumers in developing countries, accept new food products, and that the new foods can become an important part of their diets. Foods like wheat have been introduced into rice eating areas and become important food staples (e.g. in Korea and Bangladesh). At the same time, new foods, even good tasting foods developed through close interaction with consumers and introduced into developing country markets with much publicity, sometimes fail. The present state-of-the-art does not permit

decision makers to know in advance when a new product will succeed and when it will fail. In the case of introduction of soybeans as a direct food in Bolivia, the reason for failure isn't known. However the results of the project suggest that unless there is some reason to think that people will consume soybeans directly (other than that soybeans are cheaper than ordinary beans and are more nutritious), no further efforts should be made to promote direct consumption of whole soybeans.

2.9.3 RECOMMENDATIONS

It is recommended that future efforts to promote soybean consumption in developing countries should be focused on processed soybean products, such as meat and milk substitutes and extenders, flour and grit products used as ingredients in food supplements, and the like.

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2.10 SOLAR BOX COOKERS

2.10.1 PURPOSE

In past years, A.I.D.'s nutrition strategy emphasized improving the nutritional status of infants, children and women of child-bearing age. A.I.D. requested FTB to explore the use of solar energy technology to save cooking fuel and decontaminate water and thereby help reduce malnutrition and illness associated with poor water quality.

A review of solar technology for cooking led to the Kerr-Cole solar box cooker which seemed to have attributes needed for third world use. It appeared that proper development of this cooker could result in its use for cooking and also for heating contaminated water to make it free of organisms of public health significance.

A concept paper and project proposal were developed for tne modification and use of the Kerr-Cole type solar box cooker (SBC) in developing countries (10.1). The project drew on Robert Metcalf at California State University-Sacramento, (CSU-S) who had numerous years experience in the use of the SBC, to direct the studies. A USDA Cooperative Agreement was developed witn CSU-S in 1984 for the purpose of the development of tne SBC for food preparation and water quality improvement in developing countries. Tne objectives were: to evaluate the Kerr-Cole SBC as a means of decontaminating water under various weather conditions and with different micro-organisms; to establish operating conditions for cooking typical food used in developing countries; and to develop guidelines for operation of the SBC for cooking food and decontaminating water. The results of this activity development were to be utilized as the starting point for projects for the adaptation of the SBC for use in one or more developing countries.

2.10.2 PROCEDURES AND ACCOMPLISHMENTS

Extensive food cooking and water heating tests were carried-out over a period of more than a year at CSU-S. Over 30 foods of various types were used in cooking tests to establish conditions for cooking including basic cereals, legumes, roots, and vegetables typical of those used in developing countries. Information collected included length of time to cook, amount of sun energy available each day, changes in recipe, etc. The studies resulted in Metcalf being able to be categorized the foods as easy, medium or hard to cook, and establishing the amount of energy needed and how much food can be cooked when decontaminating water at the same time (10.2).

The water heating tests covered a wide variety of micro-organisms of public health significance such as E. coli, Salmonella, Shigella and Rota-virus. One gallon jugs of contaminated water were heated under all types of conditions and the water temperature, sun angle (energy level), and time of heating were recorded. The water was sampled frequently and checked for micro-organism destruction and water temperature.

Following cooking and water heating tests, food was cooked and water treated simultaneously to establish techniques for cooking a meal and decontaminating water at the same time. A system was developed for calculating the amount of food (based on the type of food) and/or water that could be processed in a Kerr-Cole SBC on a given day. The system is based on sun angle and degree of cloudiness. A formula was developed that gives a value based on geographic location, sun intensity, etc. Charts can be produced for countries or parts of countries which give values that represent the solar potential. A simple water temperature indicator device was developed by FTB which shows when the water has been heated enough in a SBC to kill disease-causing micro-organisms. The

device is made of sturdy plastic and is reusable, inexpensive and simple to use. It eliminates the need for a thermometer which requires frequent observation and which is impractical for use to determine if the water has been adequately heated under typical methods of use of the SBC.

A video tape was produced which describes the world energy (fuelwood) crisis and how use of the SBC could help alleviate the problems while fighting disease caused by contaminated water in many countries. Copies of the video tape were distributed around the world to interested parties to stimulate interest in a field test of the SBC in developing countries. The tape was sent to USAID Missions, PVO's, Peace Corp and institutions and government entities in developing countries. In addition, information about SBC appeared in several publications that are widely circulated worldwide and on VOA. More than 250 letters were received from around the world asking for information about the cooker and its use. Information packets were sent in response to each request.

The FTB budget did not provide sufficient funds for a field test so FTB sought to arrange for a cooperative project with an organization that could help defray project costs. Initial contacts with PVOs and other organizations were unsuccessful, but finally Southern University in Baton Rouge, Louisiana showed interest and agreed to undertake a project in Sierra Leone to determine feasibility of introducing the SBC. Southern University had extensive previous experience in Sierra Leone. FTB helped develop the project and in 1988 it was funded by A.I.D. It is presently underway and scheduled to be completed in December 1989. FTB provided technical assistance and support for the project including the services of Robert Metcalf.

A recent report from the project site in Sierra Leone indicated these results. About 12 of the more common foods (dishes) in Seirra Leone have been prepared in the SBC. Water treatment studies using the FTB Temperature Indicator device

show it reliably indicates when water is adequately heated to destroy pathogens microorganisms. Construction of SBCs using local materials is being carried out. The SBC technology has been generally well accepted by project participants during the initial village introduction. Introduction of the cooker in villages will continue in the Fall of 1989 after the rainy season. Southern University will submit a final report in September 1989 of work done in Sierra Leone under the USDA Cooperative Agreement with them.

Additional accomplishment include: demonstration that a SBC can cook important foods and free water of disease causing micro-organisms; development of a reusable temperature indicator that tells when water is adequately heated to kill germs; heightened awareness of SBC potential; and empetus for SBC activities that has led to demonstration workshops and project development in Bolivia, Guatemala, Djibouti, and Zimbabwe.

2.10.3 RECOMMENDATIONS

Successful demonstration in Sierra Leone of the feasibility of introducing SBC to a developing country snould encourage A.I.D. to play an active roll in further research and development of SBC technology. Also, successful outcome of the worksnops and projects in the other countries should further stimulate interest in solar technology and encourage PVO's to use this technology in their programs. The Sierra Leone project could serve as a prototype of an alternative way of cooking and water purification that can save energy, labor and lives.

2.10.4 REFERENCES

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2.11 SELF-TARGETING FOODS

2.11.1 INTRODUCTION

It has been estimated that 40-60% of supplementary foods distributed through targeted take-home feeding programs are consumed by family members other than the intended recipients. Take-home feeding is the leading method through which Food for Peace commodities are distributed and is generally considered the most practical way of reaching large numbers of program beneficiaries. If it were possible to reduce the leakage of the commodities, the effectiveness of take-home programs would be greatly increased. As one approach to reducing leakage, FTB explored the idea of a food which, because of its characteristics, would be more likely to be fed preferentially to an intended target group. Such a food was defined as "self-targeting". It was recognized that to be fully effective, provision of such a food should be accompanied by nutrition education.

2.11.2 THE KOLASA STUDY

PURPOSE

One important method by which a self-targeting food might be created is to pattern it after an existing food which is already fed preferentially to a particular group, as, for example, a traditional weaning food is preferentially fed to weaning age children rather than other members of a household. To assess the feasibility of this approach, FTB initiated a study for the Office of Nutrition in 1983 to determine the extent to which traditional foods exist which could serve as models for the creation of processed self-targeting weaning foods. The study also sought to gather information on foods fed prefentially to pregnant women.

PROCEDURES AND ACCOMPLISHMENTS

FTB arranged for the study to be carried out through a contract with Dr. Kathryn Kolasa (11.1).

Kolasa collected information about traditional weaning foods through a literature review and consultations with experts. The study identified traditional self-targeting foods in a number of countries and cultures. The most prevalent type of self-targeting weaning food was found to be a gruel fed at a special consistency for infants and young children. It also identified a few specific instances of more highly differentiated self-targeting foods. Most notable was sago, a gruel made from beadlets of cassava starch and fed to infants and children in Calcutta as a weaning food. Anecdotal reports suggested similar use of sago in other areas of the Asian subcontinent. Other types of traditional weaning foods were also identified such as certain beverages and mashed banana.

The Kolasa study was able to identify only a few reports of foods consumed preferentially by pregnant women. These were mainly herbs and beverages such as teas. Data did not permit a definite conclusion as to whether this was due to lack of reported information or because the practice is rare. The study did, however, report the widespread practice of pregnant women consuming clay or laundry starch, and this practice might provide a basis for self-targeting foods for this group.

2.11.3 NUTRITIONAL IMPACT AS A FUNCTION OF TYPE OF FOOD SUPPLEMENT

PURPOSE

Related to self-targeting foods was a concept developed by FTB and Mr. Max Rutman, Director of a Chilean consulting firm, INUAL. Mr. Rutman, while working with the Adventist Development and Relief Agency (ADRA) in Chile, explored the rate

of consumption of donated foods among children and found that certain foods were consumed to a greater extent than others. He hypothesized that foods which are perceived as "children's" foods would be more effectively delivered to and consumed by children than foods that are perceived as "family" foods. If true, Rutman's concept could be used as a basis for formulating "self-targeting" foods for distribution to children that would reduce leakage of food to other family members. He proposed a small field study of take-home feeding to test this hypothesis. The variable which he proposed to study was the type of food provided. Factors which he intended to hold constant were the amount of calories provided, packaging and nutrition education. The outputs Rutman planned to measure were amount of food consumed and the nutritional status of food recipients. Products selected for the trial included ones which were judged as particularly appropriate for weaning age children and would therefore be expected to be fed preferentially to this group.

PROCEDURES AND ACCOMPLISHMENTS

The Rutman study (11.2) was designed by INUAL and implemented in Costa Rica by CITA, Costa Rica's Food Technology Institute. It was funded by an A.I.D. small research grant and monitored by FTB.

Three products were distributed in similar packaging and with a one-time instruction on use. In addition, a large family food basket was also distributed to a fourth group.

One of the test products was a pre-cooked rice cereal which was made available in amounts of one and two kilograms per month and which furnished the child 150 or 300 calories daily. The rice product was selected on the basis of a survey of weaning practices and food preferences which suggested that it would be likely to be perceived as highly appropriate for young children on the basis of

such factors as color (white) and consistency. A bland flavor was also selected in order that the product might not be overly attractive to adults.

The second product was a cookie which was also made available in amounts equivalent to 150 or 300 calories per day. It was hypothesized that the convenience of the cookie might encourage its preferential feeding to children, but recognizing that its attractiveness could result in sharing with other family members. A third product was Nutrisoy, which was a corn-soy product similar to ICSM, a pre-cooked corn flour product used by the Food for Peace program as a weaning food; Nutrisoy was expected to be less attractive to young children than the other foods in the test since it resembled plain corn flour. Nutrisoy was distributed at the 300 calorie level. The fourth ration, a family food basket, was composed of staples such as rice, beans and oil. It provided the equivalent of 2000 calories per day for a family; the share for a young child was estimated to be approxiamtely 300 calories per day.

The products were distributed once per month in a take-home feeding program for a period of four months. A 24 hour recall consumption study was conducted at the beginning and toward the end of the study. In addition, anthropometric measurements were also taken. The most important finding of the study was that the type of food provided did appear to make a substantial difference in the amount of product fed to the child. Thus, when measured by recall and analyzed for influence of external variables, a 150 calorie rice cereal supplement resulted in twice as many calories being consumed from the supplement by the target group than the 300 calorie Nutrisoy.

The study concluded that the relatively superior performance of the rice cereal was likely due to two factors. On the one hand, prior surveys had suggested that it might be perceived as particularly appropriate as a weaning food. On

the other, unlike the cookie, its bland flavor and other characteristics would be apt to make it less likely to be attractive to other family members and therefore not leaked to them. The study findings also suggested that the significant intake of rice cereal was not nullified by a substitution effect. Changes in weight for age also provided an indication that the rice cereal supplement at the 150 calorie level was the most efficient in causing growth per calorie, but the data were not sufficiently firm to draw definite conclu-sions on this point.

2.11.4 RECOMMENDATIONS

Leakage in take-home feeding programs is a major problem. Its reduction could significantly improve the PL 480 program which is by far A.I.D.'s most important nutrition intervention reaching over 10 million recipient children. In addition to the Kolasa study and the field trial described above, two additional studies were discussed in a 1986 FTB concept paper (11.3). One was a trial in Chile which found tnat slightly acidified milk which was distributed in a large take-home feeding program was consumed to a much greater degree by children than was normal milk which was used more by the family as a whole (11.3, 11.4). The other study found that in India, food for pregnant and lactating women which had been fla-vored with a substance associated with foods traditionally consumed by this group was also preferentially consumed in comparison with other foods tried out (11.5).

These studies taken in conjunction with the Rutman study provide a good indication taht the self-targeting approach can be effective in reducing leakage. Accordingly, it is believed that the development of a self-targeting food or foods should be implemented. Specifically it is recommended that a self-targeting food should be developed which can be used in the Food for Peace

program. Approaches to food development could include: (1) packaging the food in small bags with a picture of a very young child; (2) using ingredients that give the product a white color; and (3) designing the food and the package for a specific geographic area but an area sufficiently large to make its use in the PL 480 program practical (for example there are indication that sago, a weaning food made from cassava starch, may be widely used in South Asia and a processed food patterned after sago might be designed for this large area).

2.11.5 REFERENCES

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(11.2) Rutman, M., Nutritional Impact as a Function of Variation in Type and Quantity of Supplement. Final Report from INUAL, A.I.D. Grant DAN-1046-G-1077-00. 1985.

(11.3) Weil, R., Self-Targeting Foods. USDA Special Report. 1986.

(11.4) Stekel, A. et al., Prevention of Iron Deficiency in Infants by Milk Fortification., Nutrition Intervention Strategies in National Development. Academic Press, New York. 1983.

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2.12 NUTRITION INTERVENTION BROCHURES

2.12.1 PURPOSE

This activity was initiated as a result of requests received from USAID Missions for information on new or innovative large scale nutrition programs which included a food technology component. In seeking to respond, FTB found that available information was fragmentary. Therefore, FTB proposed to the Office of Nutrition that it produce a series of descriptions of nutrition programs which stood out as having particularly innovative or effective components to distribute to Missions and others engaged in development work. The concept was to provide very readable overviews which would furnish enough information to Missions to permit them to consider possibilities for replication within their own countries. The Office of Nutrition agreed and requested that FTB prepare and distribute a series of nutrition intervention brochures.

2.12.2 PROCEDURES AND ACCOMPLISHMENTS

In 1980, FTB produced the first of a series of three brochures. This publication described the national nutrition program of Colombia, known as PAN. This large program included an element using food stamps to provide a partial subsidy for weaning foods and other nutritious foods for pre-school children and pregnant and lactating women. The brochure was written by Thomas Sanders, a professional writer, who visited Colombia and interviewed Colombian and USAID personnel. The brochure described the program's design and operation, its impact, costs, strengths and weaknesses and replicability. It was about 20-pages in length and was illustrated with photographs and drawings (12.1). The PAN brochure was circulated to USAID Missions and other interested groups. Responses from the field

indicated that the brochure was considered useful and the Office of Nutrition asked FTB to continue with preparation of additional brochures.

In 1983, a brochure on the Chihuahua program was issued. The program described in that piece represented a striking illustration of the feasibility of adaptation and use of low-cost extrusion technology with almost no external technical assistance (see Section 2.7.4). The brochure was written by Bern Keating, a technical writer, and FTB's Robert Weil and was printed and illustrated in similar fashion to the first brochure (12.2).

A third brochure was published in 1986. This piece described the Sri Lanka Thriposha Program. As also described in greater detail elsewhere in this report, the Thriposha program illustrated successful initiation of phase-over of a feeding program from imported commodities to local commodities, the capability of take-home feeding to acnieve nutritional impact, and the viability of commercial sale of a weaning food (see Section 2.7.3). The brochure was written by Irwin Hornstein with assistance from Robert Weil of FTB (12.3).

The FTB brochures were provided to a number of audiences. In addition to the USAID missions, copies were made available througn them for use by government counterparts and local PVOs. U.S. based international organizations were provided the brochures as were the headquarters of U.S. PVOs. A notice describing each brochure was also placed in several newsletters for development workers. Requests for additional copies of the brochure were received from Missions and international organizations. The Colombian Government reported that they had had numerous requests for the PAN brochure from other Andean countries and asked that it be translated into Spanish. The PAN brochure was subsequently translated and reissued (12.4). In addition, a substantial number of requests were received from private individuals and from research institutes and universities engaged in development work.

2.12.3 RECOMMENDATION

As indicated by the response to the brochures, there is a need for sharing information on programs which have innovative or particularly promising elements which can be of use to other development practitioners. It is believed that concise, readable descriptions of such programss should be prepared and disseminated in the future. As in the past, the descriptions should be carefully drafted to be both readable and focused on useful information. While this FTB series was on programs which included a food technology component, it is believed that this approacn could usefully be extended to include other nutrition programs with innovative or unusual elements.

Except for the Thriposha brochure, the pieces were produced through contract with a professional technical writer. If a future series is developed, it is believed that it would be more efficient to have the first draft prepared by an individual with considerable knowledge of A.I.D. nutrition programs and procedures and who would would be attuned to identifying the elements of the program of maximum relevance to A.I.D. This would save considerable redrafting, which was required for this series. However, after the first draft is produced, the services of a technical writer could be usefully employed to help develop a piece which would have maximum readability.

2.12.43. REFERENCES

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2.13 CHILD SURVIVAL

2.13.1 INTRODUCTION

Recent studies suggest that nearly 15 million children in developing countries die annually and that half the deaths are due to dehydration resulting from diarrhea. In addition, the synergistic effects of diarrhea and malnutrition result in stresses which contribute to additional deaths from other childhood diseases. Realizing this, A.I.D. has focused special attention on development activities that will impact CHILD SURVIVAL by reducing diarrhea, malnutrition, and life-threatening diseases among young children.

The A.I.D. program places greatest emphasis on immunization to prevent childhood diseases and oral rehydration therapy (ORT) to help children recovery from diarrhea. However it also addresses other approaches to CHILD SURVIVAL including interventions to promote breast feeding, improved use of weaning foods and other food supplements, vitamin A distribution, and other activities to improve the nutritional health of young children. In addition, A.I.D. has acknowledged that it must build on and enhance yet other interventions and that it will rely not only on available techniques but will develop new ones through innovative research.

The A.I.D. Office of Nutrition has supported CHILD SURVIVAL through a variety of projects including several in the field of food technology (such as vitamin A interventions based on food fortification and interventions to promote use of weaning foods and food supplements). However in 1986, the Office of Nutrition asked FTB to look into new ways in which food technology might play an even more important role in promoting CHILD SURVIVAL.

In November 1986, FTB prepared a discussion paper entitled "Food Technology to Enhance Child Survival" (13.1). The discussion paper noted ways in which food technology as a discipline had contributed beneficially to child survival in the past. It then outlined several new approaches based on food science and technology which FTB had identified that might improve child survival rates. The new approaches included: (1) special catch-up foods to accelerate recovery of children after episodes of diarrhea; (2) new ingredients that can be added to foods to help prevent diarrhea; and (3) improved oral rehydration therapy products. The discussion paper also suggested possibilities for mobilizing public sector resources to focus R&D on child survival. The ideas in the discussion paper were reviewed with a number of A.I.D. units and, in 1987, with Office of Nutrition support, FTB initiated activities to explore further the various ideas listed in the discussion paper. The following sections describe the exploratory activities and their outcome through September 1989.

2.13.2 CATCH-UP FOOD

PURPOSE

Of the more than 5 million deaths each year among young children which are attributed to diarrhea, it has been estimated that 2.7 million have malnutrition as a major contributing cause. In a 1986 discussion paper (13.1) FTB proposed that a significant number of deaths might be averted if those children who are brought to health posts because of a diarrhea problem are provided a special "catch-up food". The concept was that when a child with diarrhea is seriously malnourished, a special nutrient dense supplement could enable the mother to bring the child out of the danger zone rapidly and thereby reduce the risk of death. FTB estimated that 40-50 thousand deaths might be averted annually if an intensive approach using such a supplement were implemented in all maternal and

child health centers serviced by PL 480. FTB, accordingly, initiated an activity to explore the feasibility of developing a food to accelerate the recovery of malnourished children following diarrhea episodes.

PROCEDURES AND ACCOMPLISHMENTS

As a first step. FTB made an extensive effort to study the concept of a catch-up food. Based on consultation with over 30 experts, a paper describing the concept was developed (13.2). The principal findings of the paper can be summarized as follows:

1. Rates of recovery of up to 20 times normal growth have been achieved when wasted children have been fed nutrient dense supplements under clinical conditions. If the child's mother were to correctly use a similar food in a take-home feeding program, it should be possible to achieve rates of growth of as much as 5 to 10 times normal. The food should be directed to children aged six months to two years where the bulk of the diarrhea related deaths are concentrated.

2. To achieve a high recovery rate, given limited numbers of feedings and the small stomach capacity of young children, the food provided should have a high caloric density as well as a high protein and vitamins and minerals level.

3. Calculations indicate that a supplement which is one third more dense than the food supplements distributed through PL 480, could shorten recovery rates by as much as one half. Because the child would be at high risk for a shorter period, the improvement in the reduction of deaths could be 30-40% greater than would be the case if Instant Corn Soy Milk (ICSM) were to be used in a comparable program. (ICSM is the most caloricly dense food supplement available in the PL 480 program.)

4. The estimated cost per ton of the catch-up food delivered to a foreign port might be roughly 12% more than ICSM. Because recovery could be achieved more rapidly, actual cost per recovery using a special catch-up food could be about 75% of the cost if ICSM were used.

5. The catch-up food, although provided in relatively small quantities, could be made available to health centers using normal delivery mechanisms.

6. The food would complement nutrition education which should accompany its distribution.

7. In addition to use in U.S.-supplied food distribution programs, the catch-up food could also serve as a model for programs which use locally produced processed foods. The food could also play a role in

disaster relief activities where the number of high risk children is very large. Finally, the catch-up food could be made available through commercial channels. This might include normal sale or the food could be supported through food stamps and tied in with health center targeting and nutrition education.

8. FTB estimated that to produce a prototype product, test it clinically, and then conduct a field trial of impact, would require two-and-a-half years and funding of about $300,000.

To further develop and confirm the FTB catch-up food concept, two workshops were convened, one on the nutritional requirements for the catch-up food and the other on its use in the field.

In the first workshop held in May 1988, a small group of nutritionists and pediatricians with experience in rapid recovery of malnourished children and in absorption of nutrients following diarrhea was brought together. The group recommended that the catch-up food have a caloric density of approximately 140 calories per 100 millilitres (about 40% more caloricly dense than ICSM), approximately 13% of calories from protein, and a complete complement of vitamins and minerals. The group also specified other requirements such as a low osmolality and low fiber content (13.3).

The purpose of the second meeting held in September 1988, was to determine how the food would likely be used by mothers in order to have a better information base for developing the food. Individuals were brought together who were experts in feeding practices, nutrition education, and feeding programs. The group confirmed the concept that the mother should be encouraged to feed the food intensively several times a day. (This is in contrast to normal take-home feeding where the supplement is provided for longer periods of time but as a single, supplementary meal.) The group felt that mothers would probably feed the food two or three times a day. A rough range of expected consistency at which the mother might prepare the food as a gruel was also given. The group

confirmed that health center personnel could handle and take advantage of a special food. The alternative of adding oil to increase the caloric density of an existing commodity was not considered practical. Overall, the group felt that such a nutrient dense catch-up food could make a substantial contribution and that it should be developed and evaluated (13.4).

Based on the conclusion of the two expert meetings, FTB worked with Colorado State University to draw up a plan for developing a specific product. The plan worked out by FTB and CSU included further development of specification of the product's desired physical characteristics, production of prototypes, and evaluation of physical, chemical, nutritional and organoleptic properties. Projected time for implementation of the plan was six months (13.5).

In early 1989, the A.I.D. Office of Nutrition reviewed its interest in catch-up foods and concluded that development of such a food did not have high priority for A.I.D. and advised FTB to discontinue its activities on catch-up foods.

2.13.3 FOODS TO PREVENT DIARRHEA

PURPOSE

As indicated in the Introduction, diarrheal diseases are a principal cause of infant and child mortality in developing countries. While A.I.D. has focused its program heavily on treating diarrhea with ORT, FTB has explored new ways to utilize food technology to prevent diarrheal. In particular, FTB sought ways of incorporating into the diets of children, foods or food materials which will prevent diarrhea. FTB's plan was to identify foods or food materials with the capability of preventing diarrhea by retarding growth of pathogens, or other means, demonstrate the effectiveness of the materials in laboratory and animal tests, and evaluate the potential of the materials for use in humans.

PROCEDURES AND ACCOMPLISHMENTS

FTB conducted a preliminary literature search to identify foods or food materials which have the necessary properties for preventing diarrhea and found candidates in four categories of materials. These were: Antibiotics; Probiotics; Human Milk Components ; and Antibodies. Antibiotics were dismissed early as unacceptable because they might result in new, antibodic resistant microorganisms. The search led to the identification of a number of materials that might prevent diarrhea in children. However, it was concluded that a more thorough review was needed

FTB contracted with Virginia Polytechnic Institute and State University (Virginia Tech) to undertake the review and prepare a report based on an in-depth literature review, contacts with workers in the field, etc. The Virginia Tech report identified several materials that appeared to have good potential for preventing diarrhea (13.6). After meetings with experts in food science, microbiology, gastroenterology, etc. to discuss the materials identified in the Virginia Tech report, two materials were selected for experimental work to assess effectiveness in preventing diarrhea. One was a specific strain of Streptococcus faecium (SF) from the Probiotic category, and the other was a mucinous glycoprotein from the category of Human Milk Components.

A Cooperative Agreement was established with Virginia Tech to coordinate activities to be carried out regarding this subject and to conduct experimental work using the SF material. The agreement had provisions for subcontracting to other institutions for the performance of the work on glycoprotein. An advisory committee was formed to give guidance for design and evaluation of experimental work carried out under the Agreement.

During 1989, Virginia Tech carried out extensive laboratory work on the strain of SF and on several lactic acid forming organisms isolated from a pig source. In vitro laboratory tests showed the effectiveness of the cultures for stopping the growth of disease causing organisms. Generally a pathogenic strain of E. coli was used as the test pathogen. The effectiveness of the SF material was strong enough to warrant proceeding to animal testing.

A series of five pig feeding trials was carried out by Virginia Tech to demonstrate the effectiveness of the SF in stopping diarrhea in pigs after receiving a challenge dose of E. coli. Two pig trials included use of a probiotic designated 2CA which had been isolated from pigs in earlier trials and had demonstrated growth retarding properties to E. coli in laboratory tests.

Summaries and evaluations of the laboratory testing and animal trials are covered in detail in the Virginia Tech Final Report which is attached to this report.

As a part of the study, FTB met with the Bureau of Foods and the Bureau of Drugs of the U.S. Food and Drug Administration to learn about regulatory issues. FDA advised FTB that there are no rigid guidelines regarding approval procedures but suggested that it would be important for FDA to be fully informed and to participate during planning of product evaluation tests. Since health claims would be made for any new probiotic, FDA approval is required.

Johns Hopkins University was requested to conduct tests of mucinous glycoprotein effectiveness against rotavirus organisms both in vitro and in vivo (mice) through a subcontract with Virginia Tech. However, an agreement could not be reached with Hopkins so no testing of glycoproteins was done.

Several accomplishments can be noted. One is the preparation of a valuable study of the potential use of foods and food materials for preventing diarrheal

diseases in children in developing countries (13.6). Also the Virginia Tech results from tests using SF cultures to protect pigs against diarrhea-causing organisms suggested that probiotics can be effective and that work on SF snould be continued. But perhaps most important, the concept of adding materials to food to prevent diarrhea was identified and the health community was made aware of this new potentially effective health/nutrition intervention. It is recommended that A.I.D. continue to explore this approach through additional research.

2.13.4 ORAL REHYDRATION THERAPY

PURPOSE

Dehydration in young children, which often occurs during acute diarrhea, is a leading cause of death in LDC's. Oral Rehydration Therapy (ORT) is a simple, low-cost treatment to replenish body fluids and electrolytes; it replaces a costly and often unavailable I-V procedure.

The standard Oral Rehydration Solution (ORS) contains water, salts, and either glucose or sucrose. The sugar acts at the intestinal wall in a coupled reaction to permit the passage of electrolytes into the body and thus overcomes life threatening dehydration even in the presence of diarrhea. The amount of sugar that can be used in ORS is limited by its contribution to osmolality; too high osmolality will induce vomiting and aggravate purging and dehydration.

In 1985, Harold Rice, ANE/TR/HPN provided FTB with a report by Dr. Majid Molla, International centre for Diarrhoeal Disease Research - Bangladesh (ICDDR-B) on the successful use of rice flour as a replacement for glucose or sucrose in ORS. Molla called the new concept "Cereal ORS" (later it became known as "Super

ORS"). The Rice-ORS nad the added advantages of reducing stool volume and providing a higher concentration of calories per volume of ORS thus reducing growth faltering during diarrhea, a major factor in the development of malnutrition in many LDC's as children suffer repeated bouts of diarrhea. Molla suggested that even higher caloric densities might be useful to further reduce stool volume and growth faltering. At the suggestion of Dr. Rice, FTB undertook work to explore the use of extrusion cooking of cereals and other methods to prepare ORS with high caloric density but low osmolality.

PROCEDURES AND ACCOMPLISHMENTS

FTB explored two ways to increase caloric density without increasing osmolality or losing the benefit of stool volume reduction observed with Rice-ORS: (1) extrusion cooking of rice which destroys the structure of rice starch and thereby reduces viscosity of water dispersions and increases the caloric density of Rice ORS; and (2) use of maltodextrins, another derivative of starch with low viscosity.

Arrangements were made at ICDDR-B to evaluate an extruded rice flour prepared by FTB's cooperator, Colorado State University (CSU). ICDDR-B found the product yielded a Rice-ORS that could be hydrated at 80 g/liter to give good acceptability and appropriate physical and chemical characteristics. However, the extruded rice flour tended to form lumps. The 80 g/liter was a significant improvement in caloric density over the 50 g/liter that Molla found feasible with "stove top" cooked rice flour. An informal agreement was reached with ICDDR-B where CSU would carry out experiments to optimize extrusion conditions and ICDDR-B would evaluate the best sample(s) in clinical trials. CSU, using a Wenger TX-80 Twin Screw Extruder, found extrusion of rice flour at 14 percent moisture and 171 degrees C yielded the best product and could be used to produce

Rice-ORS at 100 g/liter (13.7). Unfortunately, financial constraints at ICDDR-B prevented clinical evaluation.

Maltodextrins are partially hydrolyzed starch. The degree of hydrolysis can be varied. A very low level of hydrolysis yields a maltodextrin whose average chain length is 22 glucose units giving low osmolality. Viscosity is much reduced from that of cooked starch and clear solution of maltodextrins of 30 to 40 percent (300 to 400 g/liter) are possible. A further advantage of maltodextrins is the ability to have a sterile ingredient compared to cereal flour thus improving the microbiological stability of ORS (in fluid form). Yet another advantage is the good digestibility of maltodextrins even in children less than 4-6 months old who have immature amylases but whose glucoamylase should readily hydrolyze it. Maltodextrins are commercial available as a powder or agglomerated powder. Their 1986 cost was 27 cent/pound for the powdered form and 54 cents for the agglomerated form. Raw cereal flours cost in the range of 8 to 20 cent/pound. FTB discussed Maltodextrin-ORS with several experts and organizations including ICDDR-B in an effort to arrange a cooperative program leading to clinical trials to determine the potential of Maltodextrin-ORS to reduce stool volume, vomiting, and growth faltering but were unsuccessful. Results of subsequent research, reported by WHO, indicated that Maltodextrins were not effective in reducing stool volume like rice flour.

Research by WHO and others continues on ways to improve ORS, including Rice-ORS. WHO reported funding 9 new projects in 1988. The research aims to reduce stool volume, duration of the diarrhea, and quantity of the ORS required to overcome dehydration. Other research addresses vomiting and growth faltering, both during and immediately after diarrhea.

Considering the major role now being attributed to diarrhea in the development of malnutrition in LDC's and the ability of children to digest and absorb foods during diarrhea, there appears to be significant potential to reduce malnutrition by encouraging the use of improved super-ORS. Special problems in diarrhea such as anorexia, and reduced rates of nutrient absorption suggest the need for foods of high acceptability and high nutrient density to be fed on a frequent schedule. To produce such foods at low-cost and usable under LDC conditions will require innovative food technology.

2.13.5 RECOMMENDATIONS

The A.I.D. program to promote CHILD SURVIVAL currently has high priority within A.I.D. and strong support from Congress. While the program is primarily a health program with heavy emphasis on immunizations and oral rehydration therapy, there are opportunities to develop and use new technologies as well, including the innovative approaches based on food technology which are described in this section.

Of these approaches, the development of a nutrient-rich catch-up food is the simplest and quickest to implement, and FTB strongly recommends that A.I.D. move forward with the project activities outlined in Section 2.13.2. The identification of substances to add to food to prevent diarrhea (probiotics, antibodies, etc.) is a more time consuming, more costly, and a higher risk activity, but is an approach that could pay off with much greater effects on CHILD SURVIVAL, perhaps as much effect as immunization or oral rehydration therapy. Therefore FTB also strongly recommends that A.I.D. pursue a program of research and development on food substances that can prevent diarrhea.

2.13.6 REFERENCES

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2.14 ACTIVITIES PROPOSED TO A.I.D. BUT NOT ACCEPTED

2.14.1 INTRODUCTION

During the Food Technology for Development RSSA, a number of ideas for new food technology projects were proposed by FTB but, for one reason or another, the ideas were not accepted or implemented. In some instances, the ideas were prepared for A.I.D. only as rough outlines. In others cases, the proposals were developed in condiderable detail with budgets and action plans. While the proposals were not accepted at the time of submission, it is possible that at some time in the future, they might be reconsidered and found to have merit. Accordingly, the following section outlines a number of the activities which FTB proposed for consideration by A.I.D. and which A.I.D. might wish to reconsider in the future as a part of its nutrition program.

2.14.2 WEANING FOOD SUPPLEMENT, EGYPT

In 1983, USAID/Cairo examined its Food for Peace program and concluded that it should discontinue donated food supplies for the Egyptian maternal child health program. The decision arose in part because of limited availability of U.S. Food for Peace commodities at that time, and in part because the USAID judged that Egypt was capable of supplying food for the program and no longer needed U.S. food assistance. Paul Rusby, the USAID/Cairo Food for Peace Officer, contacted GOE officials to discuss the issue.

Rusby proposed that if the the GOE wisned to continue to supply food to the MCH program, that the USAID would provide technical assistance to help identify a food which could be produced locally. Rusby also proposed that the GOE consider an innovative concept for the food which ne believed would keep costs low and at the same time provide certain logistical and programmatic advantages. His idea was to supply MCH recipients with a "weaning food supplement", a term he used to

describe a protein-vitamin-mineral concentrate that mothers could mix with cereal products already available in the household (like wheat or rice) to create a complete weaning food. Rusby's preliminary estimates suggested that the cost to the GOE of procuring and distributing weaning food supplement (WFS) would be no greater than the GOE's costs for simply distributing a donated complete weaning food supplied through FFP. The Egyptians were enthusiastic about Rusby's idea and USAID requested FTB to assist the USAID and the GOE to develop a project proposal.

The concept of using a weaning food supplement in a public feeding program was new. Although the idea of mixing a nutritional supplement with ordinary foods had been put forth in the past (e.g. Indian Multimix, a mixture of peanut flour, and vitamins and minerals which the government advocated be mixed with rice as a nutritional supplement), no one had experience with the concept in donation feeding or could predict its outcome in Egypt's economic and cultural environment. At the same time, in Egypt, where every home had access to cheap and plentiful cereal because of Egypt's food subsidy program, the savings in materials, packaging, shipping, handling, etc. of a WFS versus a complete weaning food for MCH recipients could be enormous.

In 1983, an FTB team, working closely with Egyptians, designed a project to develop and evaluate a new weaning food supplement and concurrently to modify the Egyptian MCH program for effective use of the product as a nutritional supplement. The proposed project called for the project implementers to interact with Egyptian mothers using modern consumer research techniques to identify an appropriate product. It also included steps to adapt the product to the Egyptian MCH system and simultaneously modify the MCH system, if

necessary, so that educational and other components of the program system would lead to the effective use of the food. In keeping with A.I.D.'s policy to try to maximize utilization of the private sector, the proposed project provided not only for manufacture of the product by private food companies, but exploration of distribution of the WFS through commercial retail channels thereby reducing the burden on MCH workers who are normally saddled with the onerous task of subdividing food commodities and distributing them to the beneficiaries. The final proposal was for a three year, $3.2 million project to be implemented by the Nutrition Institute with technical assistance provided by FTB (2.14.1).

USAID/Cairo agreed to fund the proposed project and the Ministry of Health approved the proposal. However, the project did not receive approval from the Egyptian Ministry of External Assistance which was concerned about allocation of foreign resources in Egypt, and the project was pigeon holed there. After long months of unsuccessfully trying to free the project in 1985 USAID/Cairo withdrew it and no further effort was made to secure GOE approval.

The concept of a special "weaning food supplement", designed to meet the cultural requirements of the country of use, has potential merit and should be reconsidered in the future. Such a food can provide nutrition supplementation to needy children at a cost no more than the cost of in-country shipping and handling of Title II commodities and therefore is a potentially viable alternative to Title II commodities in any country where the local government pays the in-country shipping and handling costs of MCH foods.

2.14.3 TITLE II PHASE-OVER

PURPOSE

Each year, the U.S. donates roughly 2.0 million tons of food commodities for use in overseas food distribution programs. The commodities are made available

through the PL 480, Title II Food for Peace program and are distributed through school feeding, maternal child health, food for work, and other ongoing feeding programs as well as through emergency feeding programs. The programs represent an enormous commitment to the welfare of people in developing countries both by the donor countries who have supplied food commodities valued in the billions of dollars, and also by the local governments and organizations who must provide the local infrastructure for the programs and pay the local costs of distribution. Collectively these programs represent the largest nutrition-oriented public health intervention in the world.

U.S. food commodities used in ongoing feeding programs have been delivered to hundreds of millions of children and pregnant/lactating women in developing countries. However the programs are not intended to continue forever and eventually U.S. food shipments will be terminated. Discontinuation of project food aid has already occured in a number of countries where economic development has led to self-sufficiency, such as Brazil, Colombia, and Taiwan. In certain other countries, local policies provide that indigenous foods will be procured to replace Title II commodities even though economic conditions remain poor, such as in Sri Lanka and India. Likewise, during periods of commodity shortages, as has occurred in the U.S. from time to time, supplies of donated commodities to recipient countries have been curtailed and local governments have been required to discontinue or reduce feeding program operations. All these circumstances lead to the need at some point in time to PHASE-OVER the programs from dependence on U.S. food supplies to utilization of local food supplies. In this context, PHASE-OVER doesn't necessarily mean that either the food or the program must remain the same. Rather it means the replacement of the program with one of equivalent purpose whether the distribution of food commodities remains or not.

The A.I.D. Office of Nutrition requested FTB to provide technical assistance to countries interested in PHASE-OVER to local commodities as replacements for imported Title II commodities used in nutrition-oriented programs. FTB did so in Sri Lanka, Costa Rica, and a number of other countries (see Section 2.7). In addition the Office of Nutrition requested FTB to examine the issue of PHASE-OVER in a more general way. The following outlines FTB's conclusions and recommendations for PHASE-OVER of food aid programs as presented at a workshop on the Nutritional Aspects of Project Food Aid convened under the auspices of the United Nations Subcommittee on Nutrition at Annapolis, Maryland in 1986 (14.2).

PHASE-OVER of Title II programs from reliance on imported foods to use of local foods requires commitment and planning by both the recipient government and the donor.

The recipient government must have serious commitment in order to meet the full financial obligations entailed in local procurement of foods. The commitment must be strong enough to pay the cost of the food used in feeding programs which often is two-thirds or more of all costs. Alternatively, the local government must have a commitment to supply equivalent inputs in nutrition education or other activities that will enable the programs to achieve the same nutritional objectives as when it was supplied with U.S. commodities. (Without inputs to achieve equivalent objectives, the program is not a PHASE-OVER activity -- it is simply PHASE-OUT or, more directly, TERMINATION). In addition, the government must have commitment to invest in efforts to select an appropriate program to replace the Title II program and to build and maintain an organization that will procure and oversee the distribution of its inputs. These all require serious long-term commitments on the part of local governments.

While on the surface PHASE-OVER doesn't appear to require commitment on the part of food donor agencies, and in fact ultimately relieves donors of commitment, orderly approaches to PHASE-OVER require certain commitments by the donars as well. These include a commitment to continue the supply of donated food until the imported foods can be replaced with local foods or equivalent (to prevent a hiatus in the program and the accompanying hardship caused to program beneficiaries), and to provide assistance to the country to develop and implement a PHASE-OVER plan.

At the Annapolis workshop, FTB offered the following suggestions to A.I.D. and other donors and to food recipient countries to expedite rational and orderly PHASE-OVER of food aid programs:

- Develop guidelines to help local governments and donor agencies determine when termination of food aid is likely to occur.
- Develop a formal understanding of the responsibilities of the donor agency and recipient country when food aid is terminated.
- Prepare an options document to serve as a check list for possible phaseover activity.
- Upgrade the state-of-the-art for the design of nutrition interventions to utilize food aid or to replace food aid programs.

It is recommended that A.I.D. reconsider the implications of food aid PHASE-OVER and develop a policy and a plan using the suggestions offered by FTB at the Annapolis workshop (14.2).

2.14.4 IMPROVING THE IMPACT OF FOOD DISTRIBUTION PROGRAMS

There is widespread agreement that food distibution programs aimed at reaching preschool children and pregnant and lactating women are for the most part only partically effective. Major problems include: (1) the food supplement is often shared with other family members thereby diluting impact for the intended recipient; (2) health inputs may not be sufficient to permit adequate absorption of the food; (3) there is often inadequate nutrition education to ensure that the food is properly used and that when the child graduates from the program, adequate nutritional status is sustained; and (4) the program reaches only a small portion of those in need.

To address these problems, A.I.D. and FTB have considered a number of potential actions, some of wnich have been discussed in other sections of this report (e.g. Catch-Up Foods, Self-Targeting Foods, etc.). A proposal will be described below in which FTB recommended a systematic approach to improving the impact of public food distribution programs.

FTB's proposal was to examine the most significant factors bearing on the lack of effectiveness of food distribution and come up with a model approach or set of approaches to address these problems (14.3). The concept of using food stamps to improve public food distribution programs is also included (14.4).

In 1978, FTB developed a paper which outlined a three phased approach to identify or develop measures to improve feeding programs and to field test these approaches in order to create an improved model for effective use of feeding programs. The first phase of the proposed program consisted of a review of the literature to determine what was known about effective feeding programs. In the second phase, small scale tests were to be undertaken to fill in gaps in knowledge of effective techniques through experimental field tests. And the

third step was to design model approaches which would address the major barriers to achieving high nutritional impact through food distribution based on the findings of the literature study and the field tests. It was anticipated that in both the second and third phases some of the elements tried out would represent innovative techniques to help solve some of the key problems.

The proposal was accepted by the Office of Nutrition but, due to problems in identifying a suitable principal investigator to undertake the activity and other program priorities, the project was not implemented.

Although there have been some advances in techniques to improve feeding programs, the programs are still not considered to be particularly effective. Unfortuneately no model is yet available which can be used to make the programs more effective.

Some persons argue that feeding programs simply cannot be made to have high impact. But instances of successful large scale programs exist and FTB believes that this argument is not valid. Furthermore, the U.S. Government is spending hundreds of millions of dollars annually on food distribution programs, and it seems incumbent on the U.S. to make these expenditures as effective as possible. Accordingly, it is believed that a systematic effort to develop effective food distribution should be undertaken.

Such an effort could follow the general approach outlined in the 1978 FTB paper which included both identification of existing effective techniques and development of measures to fill gaps where needed. However to be most effecive, the effort should be larger than that suggested in the 1978 paper. A recent suggestion by CARE, which FTB believes has merit, is for the U.S. to budget

annually an amount equivalent to a small percentage of the approriation for the PL 480, Title II program (e.g. one percent which is $5-10 million) for this type of operations research.

In addition to distributing food to vulnerable groups through feeding programs, there is another avenue for providing supplementation which could be explored as part of the systematic approach discussed above. In many cases, MCH clinics do not participate in feeding programs due to problems involved in delivering food commodities or in handling commodities with limited staff. At the same time, a segment of the group serviced by these clinics may, because of very low income and more serious malnutrition, require some type of supplementation in addition to nutrition education.

An approach which used food stamps to reach vulnerable groups was worked out in Colombia. In that program, vouchers were supplied which permitted purchase at a subsidized price of weaning foods and other nutritious foods in retail stores (see PAN brocher referenced in Section 2.12). A Colombian evaluation of the use of the food stamp approach in conjunction with nutrition education and weight charts indicated that this type of food distribution could also achieve nutritional impact. It is recommended that if a program is carried out to develop improved food distribution systems, a component should be included to explore the use of food stamps to deliver food commodities.

2.14.5 NUTRITION ENGINEERING

The problem of designing an effective low-cost nutrition intervention is extremely complex and difficult considering the current state-of-the-art. For example, malnutrition may be due to any or a combination of factors such as lack of income or food availablity, ignorance of the mother as to proper feeding

practice, infection causing lack of appetite or malabsorption, etc. Furthermore, the interaction of these factors is only partially understood. As a result of this complexity, it is diffiuclt to determine what inputs are needed to improve nutritional status.

Because the design of nutrition interventions is a relatively new field, improvement in the design nas had to rely on trial and error approaches. Obviously it would be preferred to design intervention programs based on knowledge of cause-and-effect with good understanding that certain amounts of inputs to the program will result in certain outputs from the program. In most fields, practitioners have sufficient understanding of cause and effect to know what actions to take to achieve particular results. Nutrition planners should have that same level of understanding.

In 1980, FTB proposed that a more systematic approach, similar to that used in engineering, should be applied to the problem of designing effective nutrition interventions. The objective was to develop a more effective and efficient way to achieve nutritional impact. And most importantly, the aim was to create a tool which would permit intervention designers to be reasonably certain that when implemented, the program would result in a relatively predictable output.

To initiate development of a nutrition engineering methodology, FTB worked with Max Rutman, a Chilean food technologist. During the first stage of the activity, a two year study was proposed (14.5). This study would have three elements. First, a set of tests were to be conducted on how nutritional status could be effected by variation in both type and amount of food supplement. Second, based on these tests, a methodology was to be developed for determining the type and amount of food needed to achieve nutritional impact. Third, drawing on the experience of the first two steps, a comprehensive research and

testing plan was to be develped to formulate a plan for refining the methodology and creating predictive relationships between program inputs and outputs that would form a foundation for a nutrition engineering methodology.

The methodology would be expected to have several applications. First, given a particular desired nutrition goal, and given a particular set of local conditions, the methodology was expected to permit selection of that mix of inputs which would produce the desired nutritional impact at least cost. These inputs would include not only such elements as a particular type of food and accompanying health service, but also choice of a mechanism to deliver the service. Second, the methodology would permit quantificatiion of each input selected. And third, implied in the foregoing but of particullar importance, the methodology would enable a reasonably accurate prediction of the result which could be expected from the inputs which were selected.

Due to lack of availability of funds for this rather ambitious undertaking, the proposal was not implemented. (A small test of one subelement of tne approach was carried out through an A.I.D. small research grant, see Section 2.11, Self-Targeting Foods.) Another proposal which has some relationship to the nutrition engineering approach should also be mentioned. In 1975, FTB proposed a coordinated approach to the development of effective food technology nutrition interventions (14.6).

This approach would have had several components: (1) an international food development board would be established to identify important food problems and determine and coordinate courses of action to be undertaken to solve the problems; (2) a pool of food technology talent would be created to train and augment the capabilities of the personnel of existing food technology organizations; (3) a fund would be established to undertake research on development of appropriate food technology appproaches and to initiate utilization of the

results; and (4) a group of LDC and U.S. food technology organizations would form a consortium to plan coordinated actions on development programs initiated by the food development board. Funding priorities precluded implementation of this plan. However this type of coordinated approach, if established, could constitute one means of developing and implementing the nutrition engineering approach on a large scale.

Although advances have been made since 1980, there is still no general methodology which would permit selection of the most effective and least cost mix of inputs to effect a particular nutrition goal under a given set of circumstances. Nor can we yet predict the effect in quantifiable terms of program inputs. FTB therefore believes that a need remains for the nutrition engineering approach outlined above and recommends that an activity be initiated to develop such a methodology.

2.14.6 REFERENCES

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(14.6) Crowley, P.R., International Food and Development Board and International Food Technology Consortium. USDA Proposal. March 1975.

3. RECOMMENDATIONS FOR FUTURE A.I.D.-SUPPORTED, NUTRITION-RELATED FOOD TECHNOLOGY ACTIVITIES

Food science and technology can contribute importantly to social and economic development. The contributions can be in both policy making and in providing technical assistance for program implementation. The preceding sections of this report illustrate specific examples of how these contributions have been made through the A.I.D.-funded, USDA-implemented, Food Technology for Development project. The sections also offer a broad range of recommendations regarding future activities which FTB believes merit action by A.I.D. including, among others:

- The development of a much needed nutrient-dense, catch-up food;
- Research to identify substances that can be added to food to prevent diarrhea;
- Support for PHASE-OVER of donated Food for Peace commodities to local food supplies, and expanded use of Low-Cost Extrusion Cookers (LEC) to locally produce inexpensive weaning foods and food supplements;
- Support for programs to fortify local food staples with micronutrients giving special emphasis to fortification with vitamin A; and,
- In collaboration with other disciplines, developing a methodology to design and implement nutrition programs which will have a predictable effect on improving the nutritional status of the intended beneficiaries.

FTB believes that all these activities can lead to better quality of life and improved human capital in developing countries.

A.I.D. PRIORITIES

While there are many potentially useful food technology activities which A.I.D. could support, the decision to include any or all of the activities in the A.I.D. nutrition program is, as always, a matter of availability of funds and of A.I.D. priorities. FTB believes that the activities recommended above in

Section 2 of this report should be given serious consideration when A.I.D. establishes its priorities for the future and allocates funds for its future nutrition program.

ORGANIZATIONAL AND IMPLEMENTATION CONSIDERATIONS

While A.I.D.'s Office of Nutrition has concluded that FTB's activities are not of sufficiently high priority to continue as a part of the Office's present program, the Office program could change, or alternatively, the food technology functions of the Office could be reassigned to other A.I.D. Offices which might have different priorities. If either of those things should happen, and if A.I.D. should determine that food technology as a discipline can continue to play an important part in the future of its nutrition program, there are a number of ways to incorporate food technology activities into A.I.D.'s program.

Clearly the preferred way, if resources could be made available, would be for A.I.D. to have a central Food Technology unit staffed with qualified personnel, funded at an adequete level, and mandated to carryout its mission through a portfolio of A.I.D. type projects. Realistically, however, it seems unlikely that the discipline of food technology is important enough in any of A.I.D.'s programs to justify a functional Office comparable to the Offices of Agriculture, Health, Education, Nutrition, etc. Nor does it seem reasonable that food technology is an important enough subject to have a topical budget and focus like Child Survival, Vitamin A, and the other special emphasis areas singled out by A.I.D. More realistically, A.I.D. is likely to continue to perceive food technology as a helpful tool that should be used, when appropriate, to help implement A.I.D. projects and programs, but not as a special functional or topical area.

As an alternative to a central Food Technology unit, A.I.D.'s functional offies, such as the Office of Nutrition, could maintain a staff of food technologists to manage their food technology activities by developing and overseeing projects or components of projects for their particular Offices. While this option seems more likely than the previous one, it too would require a change in A.I.D. priorities since A.I.D. is under pressure to have a lean, "do-more-with-less" staff, and the existing staff is already heavily burdened.

A third option is to draw on food technologists located within existing organizations to carryout A.I.D. programs through contracts and/or agreements. The technologists could be obtained from contractors, such as universities or private organizations, or they could be made available from sister governmental organizations like USDA. Depending on the function and scope of the activity, the choice of one or the other of these two approaches is dictated by U.S.G. procurement regulations -- the services of the private sector must be used unless a government organization is uniquely or particularly suited to do the work.

In the past, A.I.D. had determined that USDA was uniquely or particularly suited to provide food technology technical assistance to A.I.D.'s Office of Nutrition. As a part of its uniqueness and particular suitability, USDA was able to serve as in-house advisors to A.I.D. functioning not only as colleagues but as fellow government employees rather than as contractors. USDA also had unique institutional capabilities in being able to draw on the skills and know-how of all of USDA's agencies and at the same time, to obtain the support of the traditional USDA cooperator community of land grant universities through cooperative agreements. Contractors have no such access. The USDA nutrition RSSA provided a model of an appropriate and effective interagency agreement and was cited specifically in A.I.D.'s Handbook No.12 as an illustration of a

government organization fulfilling the requirements of an A.I.D. RSSA. 1/ FTB believes that this model, which was created jointly by FTB and A.I.D.'s Office of Nutrition years ago and which functioned effectively to the benefit of developing countries for nearly 20 years, is an especially good one and could be used effectively by A.I.D. in the future. The alternative is for A.I.D. to define specific tasks and procure the services of a contractor to perform those tasks.

Regardless of the source of food techology inputs, FTB believes that food technology can continue to contribute to international development and urges A.I.D. to incorporate use of food technology as a discipline into its program.

1/ A.I.D. Handbok 12, p 1-14. Jan. 8, 1987.

APPENDIX 1

CONTRACTS AND AGREEMENTS FUNDED BY A.I.D. THROUGH
RSSA's TO FTB AND ADMINISTERED BY FTB; 1972-89

COOPERATIVE AGREEMENTS

ORGANIZATION	SUBJECT	AGREEMENT NO.	PERIOD	EXPENDITURES
Am. Institute of Baking	Soy fortified breads	12-17-07-8-1637-X	1976-77	$42,000
California State Univ. (Hornet Foundation)	Solar box cooker	58-319R-6-009	1985-88	54,022
CARE/Sri Lanka	Thriposha marketing	12-17-07-2-2318-X	1978-80	4,735
		58-329R-0-213	1980-83	9,377
			Total	14,112
Colorado State Univ.	Food processing, technial assistance	12-17-04-8-1265-X	1975-76	301,301
		12-17-07-8-1728-X	1976-81	1,078,991
		58-319R-1-61	1980-83	493,285
Res. Inst. of Colo. (CSU)		58-319R-4-29	1984-85	484,624
CSU Res. Foundation		58-319R-6-019	1986-88	320,706
Colorado State Univ.		58-319R-8-002	1988-89	154,274
			Total	2,833,181

APPENDIX 1 Continued

ORGANIZATION	SUBJECT	AGREEMENT NO.	PERIOD	EXPENDITURES
Foremost Foods Co.	Commercial weaning foods	12-17-07-2-1743-X	1976-77	37,715
Harvard/MIT	Home & village weaning food	58-319R-1-86	1980-85	590,047
Helen Keller Int'l.	Vit. A fort. of MSG; Indonesia	58-319R-4-069	1983-85	13,145
	Vitamin A fort. feasibility studies	58-319R-7-005	1986-88	41,390
			Total	54,535
Iowa State Univ.	Vitamin A technical assistance	58-319-5-034	1985-89	318,793
John Hopkins Univ.	Human testing of Thriposha	12-17-04-8-1464-X	1975-76	28,431
Kansas State Univ.	Soy fortif. of wheat flour (bread)	12-17-04-8-1530-X	1976-77	19,138
League for Int'l. Educ.	Eval. PER test	12-17-07-2-236-X	1978	18,310
	Project Sustain	58-319R-4-34	1984	79,738
			Total	98,048
Meals for Millions	Leaf protein conc.	58-319R-9-55	1978-80	8,834
Michigan, Univ. of	Vit. A cost effectiveness anal.	58-319R-6-012	1986-88	49,812
Pan Am. Health Org.	Eval. Brady extruder	12-17-07-2-1613-X	1976-80	5,235
Pennsylvania State University	Vit. A iron fortif.	12-17-07-8-1972-X	1977-78	32,110

APPENDIX 1 Continued

ORGANIZATION	SUBJECT	AGREEMENT NO.	PERIOD	EXPENDITURES
Pennsylvania State Univ.	Vit. A and iron fortif.	58-319R-9-76	1979-80	2,124
			Total	34,234
Southern Univ.	Solar box cooker	58-319R-9-006	1988-89	7,400
Texas A&M Univ.	Marketing technical assistance	12-17-07-8-1826-X	1976-77	30,699
		12-17-07-8-2239-X	1978-86	156,488
		58-319-7-002	1986-89	30,078
			Total	217,265
Virginia Polytechnical State Univ.	Diarrheal preventive foods	58-319R-7-021	1987-89	46,000
TOTAL COOPERATIVE AGREEMENTS				4,458,802

INTERAGENCY AGREEMENTS

Economics, Statistics & Coop. Service; (USDA)	Marketing fortified tortilla flour	OICD-192	1979	2,292
Food Safety & Insp. Service, (USDA)	Prepare handbook on food fortification	OICD-39-4	1984	5,726
Natick Lab., (DOD)	Acceptability test for WSDM	12-36-07-3-182	1973	24,320

APPENDIX 1 Continued

ORGANIZATION	SUBJECT	AGREEMENT NO.	PERIOD	EXPENDITURES
USAID/Lagos	Soy fortif. foods (Hossco Agro Ind. Co. and ICR)	12-17-04-3-956	1974-77	30,000
		12-17-04-3-1080	1974-77	27,500
			Total	57,500
USAID/Seoul	Soy fortif. wheat foods (Sam Lip Food Co. and Sam Yang Co.)	12-17-04-3-1079	1974-77	90,000
Agri. Res. Service, WRRC (USDA)	Rice Bran Stabiliz.	NA	1979	52,473
		NA	1979	16,933
		SEA 12-14-5001-6485	1980	167,000
		OICD-45-1	1980-81	182,558
			Total	418,964
Agri. Res. Service, WRRC (USDA)	Services of Dr. D. A. Fellers in food technol.	ARS-12-14-5301-1004	1984	22,210
		ARS-53010040985	1985	67,914
		ARS-53010040986	1986	70,758
		03T587-6091H270003	1987	73,777
		03T588-6091H270003	1988	75,044
		3T589-6091H290001	1989	37,707
			Total	347,410
TOTAL INTERAGENCY AGREEMENTS				946,212

APPENDIX 1 Continued

CONTRACTS AND PURCHASE ORDERS

ORGANIZATION	SUBJECT	AGREEMENT NO.	PERIOD	EXPENDITURES
Academy for Educ. Dev.	Evaluate UNC soy utilization project, Bolivia	53-319R-9-93	1979	3,055
	Produce video on UNC soy utiliz. project, Bolivia.	53-319R-0-52	1979-80	22,787
			Total	25,842
Ackels, Alden A.	Search for purchaser of Brady Co.	53-319R-8-9	1978	23,135
	Thriposha equipment for expansion, Sri Lanka.	53-319R-1-101	1981	3,884
	Blended food feasibility, Morocco	53-319R-1-249	1981	3,313
	Eval. weaning food project in Guyana	53-319R-1-310	1981	3,879
			Total	34,211
Alexander, Janet	Soybean Util. review	40-31D5-8-00-386	1977	300
Am. Univ. Field Staff	PAN - Description of Colombian Nutr. Prog.	53-319R-9-125	1979-80	9,577
	Print PAN paper	40-3148-1-0743	1981	1,159
			Total	10,736
Archer Daniels Midlands	Supply 20 tons soy flour for Thailand	53-319R-9-210	1979	9,000
Black, Lawrence	Millet transformation project, Senegal	53-319R-1-149	1981	4,533
Bogyo, Stephen	Marketability of corn-soy food, Bolivia	12-17-07-5-1564	1976	2,465

APPENDIX 1 Continued

Bogyo, Stephen	Blended food based on Jicaro nuts, Nicaraqua	12-17-07-5-2258	1977	3,106
			Total	5,571
Bond Engineering Co.	Rice bran stabilizat. feasibility, Pakistan	12-17-07-5-2236	1977-78	1,200
Bownik, Thaddeus	Wheat fortif., Haiti	53-319R-0-72	1980	2,430
Ross, Brian	Soy flour processing, Ecuador	40-3148-0-01370	1980	2,500
Bromley, Anita	Rice fortif. with vitamins and minerals	12-17-07-5-1746	1976-77	7,500
Brown, Roy	Domestic food sources for feeding programs, Philippines	12-17-07-5-1252	1975	5,777
CARE/NY	Testing WSDM, Chile, Vietnam, India, Pakistan & Sierra Leone	12-17-04-5-865	1973-74	3,393
CARE/India	Fried snack food, India	12-17-07-2-1525	1976	6,500
CARE/Sri Lanka	Supply sorghum from Sri Lanka to CSU	12-17-07-5-1349	1975	850
Checchi	Eval. blended food, India	12-36-09-5-125	1972	2,500
Coating Place	Vit. A fortif. MSG, Indonesia	40-3148-3-00294	1982	2,600
Colorado State Univ.	LEC capabilities and limitations	12-17-07-5-1132	1974-75	93,990
Cregger, Merton	Eval. LEC Prog., local	40-31D5-7-04394	1977	475
Flint, Amos, Jr.	Local food sources for feeding programs,	12-17-07-5-1253	1975	8,262

APPENDIX 1 Continued

ORGANIZATION	SUBJECT	AGREEMENT NO.	PERIOD	EXPENDITURES
Florida, Univ. of	Use of Fd. Technol. to improve nutr. status of rural poor in LDC's	12-17-07-8-2306	1978	36,725
Foremost Foods Co.	Mfg. 9,000 lbs WSDM	12-36-07-5-185	1973	18,133
	Determining losses in FFP program	12-17-07-5-1313	1975	8,400
	Eval. quality assurance at Food for Peace	12-17-07-5-1202	1975	7,150
			Total	33,683
General Mills, Inc.	Cottonseed protein study/evaluation	12-17-07-6-1611	1976	4,246
	Eval. LEC program, local	40-31D-7-04396	1977	625
			Total	4,871
Gibbs/Cook, Inc.	Supply diesel engines for LEC, Kenya, Indonesia, and Sri Lanka	12-12-07-5-1061	1974	22,001
Globe Engr. (W. Seng)	Thriposha expansion recommendations, Sri Lanka	53-319R-1-111	1981	7,058
Gonzales, Richard	Soy fortif. bread; El Salvador	12-17-07-5-1401	1975	3,000
Graham, Thomas	FFP Title II Commodity Handbook	12-17-07-5-2055	1976	11,395
Hartson, Clive	Soy fortif. bread; El Salvador	12-17-07=5-1597	1976	5,500
Hoehle, Raymond A.	Replacements for Title II foods in LDC's	12-17-07-5-897	1974-75	24,800

APPENDIX 1 Continued

ORGANIZATION	SUBJECT	AGREEMENT NO.	PERIOD	EXPENDITURES
Hoover, William	Roti production, Pakistan	12-17007-5-1441	1975	1,485
Int'l. Venture Research	Vit. A fortif. tea, Pakistan	12-17-07-5-765	1973	18,882
		12-17-07-5-881	1973-74	33,600
		12-17-07-5-1025	1974-76	22,750
			Total	75,232
INUAL (Max Rutman)	Supplemental foods, feeding programs, Morocco	53-319R-1-250	1981	5,400
Kamel, Wadie	Vit. A planning and workshop	12-17-07-5-912	1974-75	12,500
Keating, Bern	CIATECH LEC case study	53-319R-1-159	1981-84	13,825
Koerhing Company	Eval. Brady extruder	12-17-07-5-886	1973-76	15,000
Larrison, Vaughn	Cottonseed protein study/evaluation	12-17-07-5-1612	1976	3,174
League for Int'l. Food Education (LIFE)	Improve nutr. quality of bread in LDC's	12-17-07-5-877	1973-74	6,700
Manoff, Inc.	Mass media nutr. educ., Ecuador & Brazil	12-36-08-5-106	1972	4,885
		12-36-08-5-105	1972	6,703
			Total	11,588

APPENDIX 1 Continued

ORGANIZATION	SUBJECT	AGREEMENT NO.	PERIOD	EXPENDITURES
Mass. Inst. of Technol	Interventions to improve preschool nutr.	11-36-07-5-178	1973	15,000
	Rice Fortif. Vit.&Min.	40-31D5-7-01993	1977-78	9,054
		53-319R-9-139	1979-80	19,457
			Total	43,511
Mickus, Robert	Rice bran stabilizat., Guyana	53-319R-0-92	1980	2,985
Mitra, Chitta	Eval. LDC weaning food survey	40-31D5-7-01881	1977	360
New Transcentury	Survey supplemental feeding expertise in US	53-319R-0-58	1979-80	34,095
	Weaning food, Guyana	53-319R-1-311	1981	7,023
			Total	41,118
Nichols, John P.	Bread Marketing, Korea	12-17-07-5-1031	1976	6,264
	Eval. bread marketing survey, Korea	12-17-07-5-1677	1976	3,321
			Total	9,585
North Dakota State Univ.	Millet flour properties	40-3148-0-01156	1981	250
Patterson, C. J., Co.	Soy fortif. of bread in Korea	12-17-07-5-1145	1974-75	4,038
Perrett, Heli	Review UNC soybean utiliz. project	40-3148-9-0002	1978	280
		40-3148-8-0278	1978	560
			Total	840

APPENDIX 1 Continued

ORGANIZATION	SUBJECT	AGREEMENT NO.	PERIOD	EXPENDITURES
Pineda, Roselina	PAN Translat., Spanish	40-3148-1-0629	1981	850
Ralston Purina (Wilcke)	Eval. LEC Program, local	40-31D5-7-04393	1977	671
Roberts, Hugh	Local food sources for feeding programs, Philippines	12-107-5-1251	1975	9,049
Robertson, Edythe	Feeding facilities, Honduras	12-17-08-5-1883	1977	3,708
Rodier, William	Acceptability testing of WSDM	12-36-07-5-177 12-17-07-5-901	1973 1974 Total	11,665 3,806 15,471
Schweigart, Bernard	Asian Vegetable R&D Ctr. Eval. LEC program, local	12-17-07-5-1619 40-31D5-7-04395	1976 1977 Total	3,150 314 3,464
Shuman Chem. Lab., Inc.	Vit. A fortif. MSG, Indonesia	53-319R-9-195	1980	3,913
Shuster, Herbert V. Inc.	Analyze fortified rice	40-3148-1-0646	1981	205
Slatter, Charles	Expand nutr. food prog., Jamaica	12-17-04-5-1574	1976	2,271
Smith, Gail	Mngt. of A.I.D. Info. Distrib. Serv.	12-17-07-5-2023	1977	1,944
Swift and Company	WSDM Development	12-17-04-1-887	1973-75	28,189

APPENDIX 1 Continued

ORGANIZATION	SUBJECT	ARGEEMENT NO.	PERIOD	EXPENDITURES
Vitale, Edward (Univ. of Wis.)	Marketing weaning foods; Morocco	53-319R-0-221 53-319R-1-69	1980 1980-81 Total	2,137 3,793 5,930
WARF Institute	Nutr. analysis WSDM	12-17-07-5-910	1974	4,155
Wetsel, William	Acceptability testing of WSDM	12-36-07-5-184	1973	4,666
Wilding, Dean	Assist WSDM introd. in Title II, PL-480	12-17-07-5-1171	1975	24,461
Willse, Edwin M.	Salt iodization plant, Pakistan	12-17-07-5-1849	1976-77	8,812
TOTAL CONTRACTS AND PURCHASE ORDERS				742,553
GRAND TOTAL				6,147,567

APPENDIX 2. PASA AND RSSA FUNDING ALLOCATIONS

YEAR	PASA/RSSA DESIGNATION		AMOUNT
1969	PASA TA(AJ)1-69		$104,643
1970	same		113,431
1971	same		142.102
1972	same		120,600
1973	same		167,649
		Total	648,425
1974	RSSA 1-74 / STB-083-AG-2072		600,000
1975	same		540,000
1976	same		624,160
1977	same		862,000
1978	same		865,975
1979	same		960,560
1980	same		515,000
1981	same		1,555,050
1982	same		810,000
1983	same		939,750
		Total	8,272,495
1984	RSSA STB-0831-R-AG-4207		500,000
1985	same		800,000
1986	same		800,000
1987	same		850,000
1988-9	same		517,000
		Total	3,467,000
		GRAND TOTAL	$12,387,920

NUTRITION: FOOD AND NUTRITION TECHNICAL SERVICES

931-0831

Management Review for the Period 1/82 - 5/85

Review Participants Date: May 20, 1985

AFR/DR, David Eckerson
ANE/TR, Harold Rice
LAC/DR, Paula Feeney
FVA/PPE, Hope Sukin-Klauber
S&T/N, Nick Luykx
USDA/OICD, Rod Crowley
USDA/OICD, Fred Barrett
USDA/OICD, Bob Weil

* * *

Project Background

This RSSA was initiated by S&T/N in 1968 as a means of providing food technology inputs to A.I.D. food and nutrition programs. The project paper has been amended and updated periodically, with the most recent project paper covering the period FY 83-85. The RSSA has been amended annually.

The RSSA provides for direct technical service inputs by USDA personnel and supplementary inputs by private consultants, industry, universities and others whose services are procured by USDA, using RSSA funds. Outputs include a variety of technical and advisory services related to utilization of food technology to provide low-cost nutritious foods for low income persons in developing countries. The selection of specific RSSA activities emerges from field needs and is made by S&T/N in consultation with USDA, taking into account the requirements of the S&T/N program, needs of the USAIDs, and related considerations.

The RSSA has a long history of successful service to AID/W, USAIDs, PVOs, and counterparts in developing countries. As a result, A.I.D.'s nutrition program has been furthered and a number of new concepts for reducing malnutrition have been developed and demonstrated.

The last formal review of the RSSA was January 1982 by a committee consisting of members from the S&T Bureau, Regional Bureaus, and FFP.

Review Summary

An extensive set of reference documents regarding the project was distributed to the reviewers well in advance. Five "issues" were identified beforehand to help in focusing the review. These were discussed at the meeting.

1. Has USDA provided the services specified in the Project Paper, taking into account the reduced availability of funds and the changes in priorities and program guidance by A.I.D.?

The reviewers felt the RSSA staff had been consistently very responsive to requests for services, and that the geographical distribution of service had been fairly even.

2. Have the technical assistance and support provided through this project been effective in meeting the needs of the developing countries? Of the USAIDs? Of the Regional Bureaus? Have the developing countries, USAIDs and Regional Bureaus collaborated fully in the design and preparation of scopes of work for the services provided?

The reviewers mentioned positive feedback from particular missions regarding the performance of the principal cooperating entities which participate in rendering services under agreement with USDA. Reference was also made to the positive findings being made by the PPC/CDIE technology transfer impact evaluation of the low-cost extrusion cooking (LEC) sub-project. Questions were asked about the status of LEC implementation in Sri Lanka and Ecuador, where in-country policy and on-site management concerns were affecting the program. Other questions explored activities under the "Appropriate Food Technology" component of the project, and follow-up to the earlier Senegal "Millet Transformation" undertaking.

A point was made by one of the reviewers that the RSSA staff did not have language facility in French or Spanish.

The reviewers went on to cite reference sources for descriptions of potential innovations which the RSSA staff might explore in further developing the food technology program in developing countries. Topics such as fermenting and drying were among those mentioned.

In the course of the discussion, the reviewers also suggested that the RSSA group keep itself well informed regarding activities under the "Weaning Behavior/Practices" component of the Maternal and Infant Nutrition project.

3. Have the resources provided been sufficient to meet field and Bureau needs? Have the developing countries, USAIDs and Regional Bureaus provided their "fair share" of the costs of these services?

The reviewers noted that the level of effort of the project appeared to have "levelled off," and suggested that additional effort be made to obtain "buy-ins." The RSSA leader described an endeavor to develop a "Technology Transfer Center" at the headquarters of one of the principal cooperators, which is currently being supported on an avaialble-on-request basis.

The RSSA group leader mentioned shelf projects on the study of possible "growth factors" in yogurt, and food technology approaches to the prevention of diarrhea as potential activities that could be undertaken if additional funds were to become available.

The reviewers offered several suggestions for obtaining additional resources under the Child Survival Action Program (CSAP), or via collaborative efforts with particular PVOs or A.I.D. field Missions which have funds to support technical assistance in food science and technology.

4. Has the ST/N management of this project facilitated the utilization of the services by developing country institutions?

The reviewers did not bring up any overall project "management" problems that needed discussion.

5. Should the RSSA be continued after expiration of the present PP? If so, what programatic emphasis and what funding levels should be considered in the extended PP?

The reviewers were unanimous in agreeing that the RSSA group should be continued into the future. It was suggested that a cable be sent to the field reminding the USAIDs of the available services, and soliciting their input regarding additional or new directions to be taken by the project. It was also suggested that the RSSA group canvass 10-14 PVOs that are involved in the Child Survival Action Program (CSAP), since it was likely that these PVOs might turn to the project for assistance in implementing their involvements in the CSAP. The following subject matter areas were specifically mentioned during the discussion:

The Office of Food for Peace (FFP)representative noted that FFP is becoming more interested in the quality of the commodities distributed under the program (e.g. vitamin A and protein content, soy content of blended foods, etc.). Similarly, FFP would like to know more about which commodities can be fed to people who are malnourished, or who have diarrhea. FFP would also like technical help in designing guidelines for the home processing of selected foods, in revising the commodity reference guide, and in preparing additional related field manuals.

(S&T/N, R. Crowley/N.Luykx, 7/22/85)